THE RAT

DATA AND REFERENCE TABLES

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THE RAT

REFERENCE TABLES AND DATA

FOR

THE ALBINO RAT

(MUS NORVEGICUS ALBINUS)

AND

THE NORWAY RAT

(MUS NORVEGICUS)

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PREFACE

For a number of studies on the growth of the mammalian nervous system made by my colleagues and myself we have used the albino rat. In the course of the work we frequently felt the need of referring to other physical characters of the rat to which the nervous system might be related. This led us to collect such data as were already in the literature and also led us to make further investigations. The facts gathered in this way have proved useful to us and are here presented in the hope that they will be useful to others also.

The plan of the presentation is simple. An introduction treats of the rat as a laboratory animal, indicates the methods of gathering the data, and also gives examples of our use of the tables. This is followed by an outline of the classification of the common rats and by a brief statement of the history of the rat since it arrived in western Europe.

The rest of the book falls into two parts. The first part deals with the domesticated albino rat—concerning which we have the larger amount of information.

The second part deals in a similar way with the wild Norway rat—the form from which the Albino has been derived. In connection with each part the several reference tables and the formulas employed for them and for the corresponding graphs are given, and at the end of the book a list of papers on the rat is added.

In the two parts which form the body of the book the purpose is to present for the rat under normal conditions the fundamental observations—giving data and conclusions only. It is hardly necessary to add that in most directions our information is fragmentary.

For all the formulas which apply to the data coming from the laboratories of The Wistar Institute, I take pleasure in thanking my colleague, Dr. S. Hatai.

For aid in the preparation of these pages I am also much indebted to those unnamed assistants to whose lot has fallen the greater part of the computations for the tables and whose devotion to their work has added a human interest to a task otherwise monotonous.

To the many authors whose results are here briefly cited or quoted in extenso I take the opportunity to express my obligations—very sincere obligations—for experience shows that such results come only by hard labor.

Many of the illustrations have been taken from the journals in which they were originally published and my thanks are due to the editors and publishers of these journals for the privilege of reprinting the illustrations here.

During the preparation of this book my immediate colleagues have given me encouragement and aid, and I cherish the hope that, should the occasion arise, both of these will be again forthcoming to help mend the gaps and rectify the errors which a close scrutiny of these pages is certain to reveal.

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THE RAT

INTRODUCTION

The Norway rat, Mus norvegicus, is the one mammal now easily obtainable both wild and as a domesticated form. This latter is represented by either the Albino or the pied rats so common in our laboratories.

The Albinos are clean, gentle, easily kept and bred, and not expensive to maintain. They are omnivorous, thriving best on table scraps. The span of life is about three years and breeding begins at about three months. Furthermore the species is cosmopolitan. The litters are large and may be had at any season. The young are immature at birth. The domesticated Albino crosses readily with the wild Norway. The rat, both wild and domesticated, takes exercise voluntarily and is susceptible to training. It is also highly resistant to the usual wound-infecting organisms. For a number of lines of study therefore, the rat seems to be a peculiarly suitable animal.

Through the researches of several investigators at The Wistar Institute (since 1906) and through those of E. H. Dunn and of J. B. Watson at the University of Chicago, of Chalmers Watson and Sir Edward Schäfer at Edinburgh, of C. M. Jackson and L. G. Lowrey at the University of Missouri, of J. R. Slonaker at Leland Stanford University, of T. H. Osborne and L. B. Mendel at Yale University, of E. V. McCollum at the University of Wisconsin, as well as through those of several other investigators both in this country and abroad, there has been gathered a considerable body of data applying to the weight and size of the domesticated albino rat and its parts, as well as some similar data applying to the wild Norway rat, the parent species. It is the body of facts so gathered that it is our purpose to present, as far as possible in tabular form.

Attention should be called to the fact that the observations presented in the tables have been made mainly on rats in the first year of life and but rarely on those which are older. It follows from this that the data apply to the rat in its most vigorous period and do not give information that can be used for the study of old age.

Since the quantitative data appearing in the tables are biological, they naturally exhibit more or less variability and reflect in each instance something of the conditions under which they have been obtained. It follows therefore that they must not be expected to possess the precision of physical or chemical determinations. Nevertheless, so long as the values here presented are not mistaken for absolute standards representing ideal or final determinations, they may be used with advantage.

Most of the matter presented is taken from researches already published in full, but in a few instances data from work in progress have been included also. In the latter instance the author's name is followed by (MS with date) when it is based on work conducted at The Wistar Institute—while in other instances the laboratory is also named.

In a few of the published tables—mainly from our own laboratory—it has been found necessary to make corrections—so that when the tables here printed do not agree with the originals, it is to be assumed that the changes are due to revision.

Owing to the absence of tables for the normal animal or to the failure of the authors to express their results in a quantitative form, much of the literature which is cited is unaccompanied by any text. Such papers however often contain valuable information on either the Albino or Norway rat and the citation of them serves to indicate the range of the studies in which this animal has been used.

Extensive reference tables have been computed for the various characters only as these appear under normal conditions, while the modifications which may be experimentally induced in these characters are merely mentioned in the text or presented very briefly.

In a number of cases the results are represented by both graphs and tables. The purpose of the graphs is merely to furnish a general view of the form of change which occurs, while for the exact values, the tables must always be consulted. In those tables which are based on size, the body length of the rat, because it is least subject to incidental variations, is the measurement to which the others have been referred.

It is recognized however that some of the characters are functions of age and in that case it is of course necessary to know the age of the animal in order to obtain satisfactory results.

All of the longer tables are based on formulas. These formulas are those for the graphs which most closely fit the observed values—and their utility lies in giving precision to the values obtained and in making possible interpolations:—as a rule however they cannot be used for extrapolation. In this connection determinations of the normal variability are always wanted, yet although this need has been met in a measure, it is far from being satisfied.

Since heretofore tables of this nature have not been commonly available, a word as to their use is in order.

There exist now—and there will probably continue to appear—strains of the Albino having physical peculiarities related to the locality in which they are bred: e.g., a relatively short tail. The treatment of such an instance by the use of the tables is considered in the paragraph which follows.

As has been stated, the tabular values here given apply to the stock strain reared at The Wistar Institute and furnish data from which deviations found in other local strains can be measured. In all experimental work it is now generally agreed that the control and the test animals should be taken from the same litter, and the determinations of any modification made within the litter—the results for the several litters being given the same statistical weight in the subsequent computations. While this procedure might at first seem to render the reference tables superfluous, yet to compare the results from two laboratories working with different local strains, having according to the example chosen different normal tail lengths, a series of reference values

such as the tables furnish, serves to reveal the relations in which the *control animals from the respective laboratories* stand to one another, and thus permits a more trustworthy comparison of the experimental results.[1]

Moreover in the course of routine work on the same colony one cannot be sure that the animals retain during successive years the same relations to the reference table values. For this reason we have been following the custom of referring all measurements to the reference tables and using the difference in deviation shown by the controls and by the test animals respectively as the measure of the modification experimentally produced,

By using such a procedure—in place of the assumption that the control animals from the same colony remain similar—the experimental results obtained from year to year are made fairly comparable with one another.[2]

But there is still another use of the tables which is perhaps the most important of any. In all experiments on the relative weights of parts or organs in which the size of the test animals differs from that of the controls, we readily obtain by weighing or measuring the differences for the entire animal. If however we wish to determine whether the relative size (weight or length) of the parts or organs of the test animals has been affected, we find that this cannot be done by comparing the test and control groups directly—for the relative values of parts and organs differ with the absolute size of the animal—but it can be done by reference to the tables in which the desired values are given ac-

[1] If a strain appears in which the length of the tail is on the average 4 per cent below the reference table value then if we compared directly with them the test animals which came from a strain normally in agreement with the reference tables—but which through experiment had had their tail length reduced by 3 per cent—it follows that the test animals, though modified by experiment, would still have relatively longer tails than the first strain.

Consequently to compare with each other the results obtained from the two strains, the deviations of both the controls and the test animals from the reference table values must be determined *in both series* and the differences within the series be used for the cross comparison.

[2] The same principle and procedure as described in Note 1 applies to the treatment of different series taken, for example from our own colony, at different times.

cording to body weight or body length or age, as the case may be. Thus by the use of the tables the determinations of the deviations shown by the test animals taken individually can be made and these values compared with the corresponding individual determinations for the control group.[3]

One further use of the tables when these are based on age, may be mentioned. The comparison of the experimental re-

[3] When the experimental conditions produce control and test animals different in size a determination of the relative size of any organ cannot be made directly or by the assumption that its normal size is in proportion to the body lengths or body weights of the contrasted groups—but only by comparison of the observed values with previously established normal values.

The following observed values are taken from Hatai ('15 a), Table 3. D. Normal females—1914 series. They read as follows:

GROUP	RATION	BODY LENGTH	BODY WEIGHT FINAL	BRAIN WEIGHT
		mm.	*gms.*	*gms.*
Controls........	Mixed	185	137	1.729
Test animals....	Lipoid free and egg fat	162	100	1.569

It is desired to determine in this case whether the relative brain weight of th test animals has been modified by the lipoid-free ration.

The absolute brain weight of the test animals is 0.160 grams less than that of the controls or 9.2 per cent of the larger number. If we assume that it should be in proportion to the observed body lengths it appears that the expected brain weight in the test animals would be 1.540. Hence the observed value, 1.569, is about 2 per cent high—by such a determination.

If we assume on the other hand that it should be in proportion to the observed body weights it appears that the expected brain weight in the test animals would be 1.262. Hence the observed value is some 20 per cent too high by this determination. No one of these procedures is justifiable though examples of their use can be found in the literature. The only correct method is to compare the observed values with the reference table values for the brain weights of animals having the body lengths of the controls and test animals respectively—to determine in each case the percentage difference between the observed and the table value and finally to compare these percentages.

Using table 68 and reading the values for the females, we find that in this case the controls are 0.053 grams or 2.97 per cent below the table value while in the test animals the corresponding differences are 0.103 grams or 6.16 per cent.

The brain in the test animals is therefore smaller than that of the controls by (6.16–2.97) = 3.19 per cent and this value may be taken as expressing the experimental modification of the brain in this series.

The foregoing represents the procedure to be generally used for determining modifications in the relative weight of any organ.

sults obtained on animals with the corresponding results on man has heretofore been difficult because of the absence of a good basis for comparison. We have found reason to assume that in the case of the rat the postnatal span of life of three years is approximately equivalent to the span of ninety years in man—or to put it another way, that the rat grows thirty times as fast as man. This ratio appears to hold for fractions of the span of life, as well as for the entire span. All of the data for the Albino, based on postnatal age, may therefore be compared fairly with the corresponding data for man, if the time intervals are taken as one for the rat to thirty for man.[4]

Finally it is desirable to explain here a seeming inconsistency in the arrangement of the material presented. In the Preface the statement is made that Part I deals with the albino rat, while Part II deals with the Norway. So far as all of the important tables and records are concerned this statement does not need revision.

[4] As an example of the comparison of the rat with man in respect to certain changes which are related to age the observations on the percentage of water in the brain may be quoted—Donaldson ('10):

TABLE 1

Comparison of the percentage of water in the encephalon of man and the albino rat at corresponding ages

W = Weisbach, 1868 K = Koch and Mann, '09

MAN		RAT	
Age, years	Percentage of water	Percentage of water	Age, days
Birth	88.3 (W)	87.7	Birth
2 years	81.1 (K)	81.3	26 days
9.5 years	79.2 (W)	78.6	115 days
25 years maturity	77.0 (W) 77.8 (K)	77.7	290 days

In table 1 the data for man, collected from various studies, are compared with data for the rat—on the assumption that the conditions in the rat brain at any age will be represented by those in the human brain at that age *multiplied by thirty*.

It has been found however in arranging the literature that it would prove most useful to include in Part I all of the incidental and general observations on the wild Norway, on the ground that these applied to the entire species, and to reserve for Part II the more precise data which apply to the wild Norway, as contrasted with the domesticated Albino.

The reader therefore will find in the literature cited in Part I papers referring to M. decumanus, M. norvegicus and Epimys norvegicus as well as to the Albino (M. norvegicus albinus or var. Albino), sometimes designated the 'white' rat.

As will be pointed out in the section on The Early History of the rat, there is one more complication in this connection. Through an error, unfortunately perpetuated by some of the natural histories, the common Albino has been described as an Albino of the house rat—Mus rattus.

It thus happens that in some of the papers cited it is reported that the observations had been made on Mus rattus or ratus (sic), the word albino being sometimes added—sometimes omitted. In a few instances it is impossible to determine whether M. rattus is used for the Albino or whether the house rat was really studied.

In forming a judgment on these cases it must be kept in mind that for the last half century the house rat has been rare and hard to obtain both in western Europe and in the northern United States, so that unless the author gives good evidence for the name he has employed, it becomes highly probable that he was working with some form of the Norway. For these reasons it has been found most convenient to include also in Part I all the references to the house rat (Mus rattus).

CLASSIFICATION AND NOMENCLATURE OF THE COMMON RATS

Up to 1881 Mus (Linnaeus, 1758) was used as the generic designation for both the rats and mice. In 1881 Trouessart proposed the subgenus Epimys for the larger forms, the rats, reserving Mus for the smaller forms, the mice—Mus musculus being the type. In 1910 Miller established the use of Epimys for the rats and the change has been accepted.

In the pages which follow however the designation Mus has been retained for the rat—as the older term is well understood, while the new term—Epimys—is at present generally unfamiliar.

The following condensed citations of the place of the original descriptions—with some of the associated references—serve to give a brief history of the nomenclature.

MUS, Linnaeus, 1758
EPIMYS, Trouessart, 1881—Miller, 1910.
—norvegicus, Erxleben (1777 descr. orig.)
—*decumanus*, Pallas (1778).
—*aquaticus*, Gessner, 1551.
Cosmopolita; ab Asia occident. in Europam navibus translat. et inde in omnes Orbis Regiones.
—rattus, Linnaeus (1758 descr. orig.)
Cosmopolita; ab Asia occident., in Europam a navibus translat., et inde in omnes orbis regiones.
—alexandrinus, Geoffroy, (1812 (or 1829 vide Sherborn, 1897) descr. orig.)
Asia minori, Arabia, Aegyptus, Algeria, etc.
Italia, Hispania, Gallia merid.—orient. et occid., et inde in omnes orbis regiones.

Since attention was called to Erxleben's description in 1777 (Rehn, 1900) his specific name, norvegicus, as the designation for the common brown or Norway rat, has been used in place of decumanus (Pallas, 1778). The designation norvegicus is now well established and will be used here.

There seems no question that Mus rattus and Mus r. alexandrinus are related to one another as color varieties of the same species (de l'Isle, 1865; Millais, '05) and they are so considered in the following pages. For convenience we shall use the term Norway or Norway rat for Mus norvegicus—and the term Rattus or house rat as a general designation for both Mus rattus rattus and M. rattus alexandrinus unless the occasion calls for the precise name.

Albinos of the house rat have without doubt existed in the west of Europe at one time or another ever since this form overran that region (Topsell, 1658) and one or more such skins as well as pied skins, from animals taken within the past fifty years, are in several of our United States museums.

At present Albinos of the house rat appear to be not uncommon in India (Lloyd, '12) where the house rat population is large. In western Europe and other regions in which the house rat population is waning, a careful search by several investigators during the last decade has failed to reveal a living albino specimen.

At the present time, therefore, the Albino of Mus norvegicus is the only albino variety generally found. In these pages this form is designated Mus norvegicus albinus—when the name is given in full, but where possible the single word Albino is used for it.

When the albino variety is mentioned here the strain as commonly reared is the one meant. As a rule this strain is far removed from its wild ancestor and moderately inbred. It may be conveniently designated as the common albino strain. In the colony at The Wistar Institute, we have in addition to this a closely inbred strain reared by Dr. King and also a strain of 'extracted' Albinos. These latter are the Albinos descended from the F_2 generation of hybrids from the wild Norway and the domesticated Albino.

During the first few generations after their appearance, these extracted Albinos show clearly certain Norway characters, which distinguish them from the rats with a longer albino ancestry. With the peculiarities of either the inbred or of the extracted strain, we are however not specially concerned at the present time.

While all Albinos breed true as to color, the composition of the gametes is undoubtedly different among them in accordance with their remote ancestry. Mudge ('10) recognizes thirteen gametic types. The gametic dissimilarity of various Albinos in respect to hair color is shown by the fact that in breeding tests (Doncaster, '06 and Mudge, '10) Albinos extracted from ancestors with characteristic differences in pigmentation will reveal their origin by producing, when crossed with the pigmented strain, characteristically pigmented descendents, the markings of which can be predicted.

We are naturally concerned with the gametic composition of the general population of Albinos constituting our colonies today. As the several colonies stand, the Albinos forming them do not

form a strictly homozygous population, even from the standpoint of color, since in subsequent crosses with pigmented forms they give offspring with different color markings according to their several latent characters. On the other hand it may be fairly said that as yet we have no evidence for any correlation of the somatic characters so far studied, with those slight differences in gametic composition of the common albino strain which we can recognize. It is to be noted moreover that the difficulty which thus appears in the case of the albino rat repeats itself for other mammals also, and therefore it does not constitute a peculiarity of this animal.

CLASSIFICATION: REFERENCES

Alston, 1879–1882. Blasius, 1857. Doncaster, '06. Erxleben, 1777. Geoffroy, 1812. Gesner, 1551. l'Isle, 1865. Linnaeus, 1758, 1766. Lloyd, '12. Millais, '05. Miller, '10. Mudge, '10. Pallas, 1778. Rehn, 1900. Topsell, 1658. Trouessart, 1881, 1897, '10. Tullberg, 1900.

EARLY RECORDS AND MIGRATIONS OF THE COMMON RATS

The common wild rats in the United States usally live in close association with man. There are two species of these, both of which have been introduced from Europe. These are Mus rattus (Linnaeus, 1758; 1766 = Mus rattus rattus, Millais, '05) together with its gray form, Mus alexandrinus (Goeffroy, 1812; = Mus rattus alexandrinus, Millais, '05) and Mus norvegicus (Erxleben, 1777 = Mus decumanus, Pallas, 1778). This last species is our common gray, brown or Norway rat. In addition to these, all of which are wild, there is a fourth form—the albino rat (Mus norvegicus albinus) a variety of Mus norvegicus (Hatai, '07) which is known at present only as a domesticated strain (Donaldson, '12 b).

Mus rattus—the house rat—the first species described in western Europe, is probably indigenous to India.[1] As now found,

[1] Fossil remains of the rat (Mus rattus) are reported in the pliocene in Lombardy (Cornalia, 1858) and in the quaternary at Molina di Anosa near Pisa (Forsyth Major) and again from the pleistocene cave deposits of the island of Crete (Bate '12). This species appears in glacial times (Diluvialzeit) and in association with man in the remains of the Lake dwellers in western Germany and in Mecklenburg (Blasius, 1857). It is reported also from the diluvial deposits in Bohemia (Woldřich, 1880).

the melanic form of Mus rattus (or Mus rattus rattus, Millais) the 'black' rat, is more frequent in the colder latitudes, and Mus rattus alexandrinus (Millais) the gray form (the 'roof' or 'snake' rat) in the warmer latitudes, but the two are not sharply segregated. At the same time both of these seem more dependent on warmth, or more resistant to it, than the Norway rat.

Although we shall have little to say in the following pages about Mus rattus, yet it is desirable to give its history in order to obtain the proper setting for Mus norvegicus, at present the dominant species. The geological evidence just given indicates the very early appearance of the house rat in Europe but our records of its migrations all fall within the present era.

The history of the early migrations is of necessity vague and incomplete, and even in the later times when dates are given it must be remembered that such animals might have been present for some time without appearing in numbers sufficient to cause comment.

There is no good evidence that the Greeks or Romans before the present era were familiar with the rat as a pest, and therefore, even if present, it was probably not abundant at that period on the shores of the Mediterranean.

The history of the house rat from the earliest times to the eleventh century makes an interesting archaeological study, but the conclusions which may be drawn from the scanty records and indefinite allusions are too uncertain to be of value for our present purpose and we therefore pass directly to the later authors.

Possibly as far back as the migration of the hordes (Völkerwanderung, 400–1100 A. D.) and later in consequence of the increasing use of trade routes with the East, the house rat entered western Europe in appreciable numbers (Hehn, '11). It is reported to have arrived there after the twelfth century (Keller, '09, citing Theodoros Prodromos). Giraldus Cambrensis,[2] (1146?–1220) records several anecdotes concerning it.

[2] Albertus Magnus (d. 1280) is sometimes cited as having mentioned the black rat. This is not correct. A. de l'Isle (1865) has pointed out that the description in question applies to the dormouse—Myoxus quercinus.

As the Norway rat did not reach western Europe until 1727–1730 it follows that the European rat of the middle ages, the rat of the legends of the Pied Piper[3] (1284), of the great plagues (before 1700) and of the early anathemas against vermin, was Mus rattus.

The species first brought to South America on the ships of the very early explorers was Mus rattus (Vega, 1609; de Ovalle, 1646). Pennant (1781) gives 1544 as the date of arrival in Peru.[4] We have also a notable instance of a plague of these rats in the Bermudas in 1615 (Lefroy, 1882).

Of the two species in question, Mus rattus is alone recognized by Linnaeus in his Fauna suesica 1746, and in his Systema (1758 and 1766). It does not concern us here to follow the history of Mus rattus in the United States further than to say that this species only (represented by the two forms) was present up to the time of the arrival of the Norway rat in North America toward the end of the eighteenth century, and that Mus rattus rattus—the black rat—is still found in a number of scattered localities in the northern United States, while in the southern states, Mus rattus alexandrinus is much the more common. It does not appear that either of these forms has ever penetrated far into the interior of the country.

Turning to the cosmopolitan Mus norvegicus—the species at present established in China, Japan, India, western Europe and temperate North America—we find that the historical record of its movements, though by no means complete, has the virtue of being recent.

v. Gesner (Historia animalium, 1551) mentions a Mus aquaticus which appears to be the form now called Norvegicus, but apparently he himself had never seen it.

According to Pallas (1831) the Norway rat invaded Europe from the East early in the eighteenth century and was observed

[3] It may be noted in passing that the ancient inscriptions in Hameln relating to the Pied Piper do not mention the rat (Meinardus, 1882).

[4] Pennant (1781) says there were no rats in South America before the time of Blasco Minez. Minez is evidently a misprint for Núñez; Blasco Núñez being the first Viceroy of Peru, from 1544–1546.

in large numbers crossing the Volga in the Russian province of Astrakhan. Pallas gives 1727 as the year of this migration. In view of other dates, this can hardly be the date of the first invasion. The Norway rat reached England—probably by ships—about 1728–1730 (Donndorff, 1792) and was soon designated the 'Hanover' rat by those who wished to connect the misfortunes of the country with the recently established house of Hanover.

There is however no reason to suppose that the Norway rat had yet reached Germany and the name has a political rather than a scientific interest.

In 1750 the Norway rats are reported (Donndorff, 1792) to have reached eastern Prussia and in 1753 they were noticed in Paris (Donndorff, 1792). Their early distribution to other localities in Europe need not be recounted, but there is evidence that they spread rapidly and soon displaced more or less completely the Mus rattus which had preceded them.

This historical sketch shows that the migration of Mus rattus into western Europe antedated that of Mus norvegicus certainly by some six hundred years, but the Norway rat being the more pugnacious and powerful species has become dominant wherever it has followed the earlier form.

This dominance is undoubtedly due in part to these characters of the Norway, but it seems probable that the progressive disuse of wood as a building material has been a factor also (Przibram, '12).

We find however that in many places, both in Europe and the United States, where the house rat was thought to have been exterminated, it still survives in small numbers.

The arrival of the Norway rat on the north Atlantic seaboard of the United States is usually given as 1775 (Harlan, 1825). The exact date, though of interest, is hardly important for our present purpose.

Mus rattus was already in possession, but in the course of the years, how rapidly we do not know, the Norway rat became the dominant form in the northern latitudes of this country—moving along the trade routes to all points which furnish a continuous food supply and a moderate summer temperature.

In the present connection our interest in the Norway rat is due mainly to the fact that the common albino rat (M. n. a bi-nus) kept as a pet or laboratory animal, and concerning which we desire all possible information, is a variety of the Norway rat. This relationship is shown not only by the usual methods of comparison, but also by the haemoglobin crystals (Reichert and Brown, '09) the shape of skull (Hatai, '07 c) and the fact that the two forms interbreed freely.

Concerning the place and time of origin of the albino strain there is little information at hand. Allusions to albino rats before the time when the Norway rat appeared in Europe clearly show that there must have been an albino strain of Mus rattus. What we know of the present distribution of Albinos of Mus rattus has been given on pages 8 and 9 in the preceding chapter.

By some curious slip however, many of the natural histories and books of reference speak of the common Albino as an Albino of Mus rattus. This of course is not correct, but owing to the confusion thus early introduced, it is difficult to trace the history of the present albino variety[5] of the Norway.

We do not know whether the common albino variety had a single or multiple origin, or whether the colonies found in Europe (Rodwell, 1858) are directly related to those now existing here. Moss, 1836, mentions Albinos in or near Bristol, England about 1822. In their general physical characters the European and American Albinos are similar (Donaldson, '12 and '12 a). Judging from the way in which the Albinos of other species arise, we may safely assume that the present strain is derived from one or more albino mutants or sports (Hatai, '12). These must have been captured and the albino descendents segregated and kept

[5] Unfortunately there is one more complicating circumstance—namely, the existence of a melanic variety of Mus norvegicus. This melanic variety is often mistaken for Mus rattus rattus because of its color, and this leads to errors of statement concerning the distribution of Mus rattus and also concerning the ability of the two species—rattus and norvegicus—to interbreed. They are in fact mutually infertile (Morgan, '09). The number of incidental allusions to this melanic variety of norvegicus shows its occurrence to be widespread. See: Edwards, 1871, 1872. Hamy, '06. l'Isle, 1865. Lapicque and Legendre, '11. Schäff. 1891. Webster, 1892.

as pets, as at present[6] there is nowhere to be found an established colony of Albinos living in open competition with the common Norways or with forms of Mus rattus, but all of the colonies are maintained practically under conditions of domestication.

In the northern United States, except along the water front of the larger ports, where the house rat arrives from time to time on vessels, we have therefore to deal almost exclusively with the Norway rat. The Norway has been in this region probably not more than a hundred and fifty years. Though living wild, it is more or less dependent on the food conditions found where man is established. The familiar Albino—Mus norvegicus albinus—is a sport derived from the wild Norway, and is the form on which most of the investigations here presented have been made.

EARLY RECORDS AND MIGRATIONS: REFERENCES

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Rattenkönig.
Ahrend, '03. Demaison, '06. Dollfus, '06. Koepert, '04.

[6] Rodwell, 1858, page 10, mentions what may have been a colony of Albinos living wild at the Ainsworth Colliery near Bury, England.

PART I

ALBINO RAT—MUS NORVEGICUS ALBINUS

CHAPTER 1

BIOLOGY

1. Life history. 2. Span of life. 3. Puberty—ovulation—menopause. 4. Period of gestation—lengthening of the gestation period. 5. Superfecundation—Superfetation. 6. Fecundity and weight at birth. 7. Recognition of sex. 8. Sex ratio. 9. Body weight according to sex. 10. Behavior. a) Under natural conditions. b) Under experimental conditions.

1. *Life history.* The albino rat is born blind, hairless, with a short tail, closed ears and undeveloped limbs. It responds to contacts and olfactory and taste stimuli, utters a squeaking sound and is capable of some locomotory movements which are a combination of wriggling and paddling. The head is always searching. The young can find their way back to the mother at about ten days of age (Watson, '03). The eyes open at from the 14th to the 17th days, most often on the 15th or 16th. King has also observed that in a given litter the eyes of the females usually open some hours before those of the males. For some seven days more, i.e., up to the time when the young rats are 21–22 days of age, they are dependent on the mother. After this they may be weaned, although if permitted, the young will depend partly on the mother for some days longer.

This adjustment of relations fits with the fact that the female may be impregnated one or two days after casting a litter (Kirkham, '10; Kirkham and Burr, '13) and since the gestation period is about 21.5–22.5 days, this would enable the female to free herself from the first litter before the second one was born. As will be pointed out later, the gestation period may be prolonged in nursing animals.

When the young rats become habituated to independence, i.e., at about 25 days, they enter on a period of activity, the phases of which have been followed by Slonaker ('07, '12). In the cases which he observed, it was found that increasing age was accom-

panied by increasing activity up to the age period of 87–120 days, after which the activity declined.

On the assumption that the span of life in man is thirty times that of the albino rat (Donaldson, '08) this age of greatest activity would correspond to the age of 7.5–10 years in man.

As shown by the records of activity (Slonaker, '12) the albino rat is nocturnal. This habit can be modified more or less by feeding or by disturbance during the day time.

The measure of activity in the cases observed by Slonaker was the number of turns of the revolving cage in which the animal was kept, the cage being set in motion by the voluntary running or other movements of the animal, and the revolutions being automatically recorded. In the case of four rats kept in separate revolving cages from 30 days of age until natural death, the following record of activity was obtained (Slonaker, '12).

TABLE 2

Total number of miles run during life

AGE IN MONTHS AT DEATH.	RAT NO. 1 M. MILES	NO. 4 M. MILES	NO. 2 M. MILES	NO. 3 F. MILES
25	1265			
26		1391		
32			2098	
34				5447

This table shows not only great variability in the total performances, but also for the one female a record of over five thousand miles in a little less than three years. On the average, three-fourths of the total distance is run before the rat has reached middle life, and the last months of old age are always marked by greatly lessened activity.

2. *Span of life.* The assumption has been made (Donaldson, '08) that dating from birth, the span of life of the albino rat is three years. A rat three years old therefore may be regarded as corresponding to a man ninety years old. So far as this assumption has been tested, it appears to be a useful approximation.

Slonaker ('12, '12 a) working at Leland Stanford University under the favorable climatic conditions of California, has made some direct tests.

Four albino rats living in revolving cages attained an average age of 29.5 months, while three control animals reared in stationary cages, but under conditions otherwise similar, attained an average age of 40.3 months. In all these cases, death was reported as due to 'old age.'

The average age of these seven individuals was about 34 months, while the greatest age, attained by one of the controls, was 45 months. The three controls all lived longer than any of the four in the revolving cages. It appears from this that living in the revolving cage shortened the span of life—an unexpected result.

3. *Puberty—Ovulation and Menopause.* Sexual maturity as indicated by the structure of the gonads usually occurs in both males and females at the age of about two months or less.

According to our observations, puberty in the female may occur at 60–70 days after birth—although the females usually begin to breed at 90–100 days. On the other hand there are occasional instances of remarkable precocity. In the breeding Albino it is found that impregnation most readily follows 1–4 days after a litter has been cast. This accords with the time of ovulation (Kirkham, '10; Sobotta and Burckhard, '10; Kirkham and Burr, '13). During the breeding season of the female ovulation occurs at intervals of about three weeks, but only from April to October do the females regularly ovulate 20–48 hours after parturition (Kirkham and Burr, '13). The menopause commonly appears at the age of 15–18 months, but King (MS., '15) reports a female 22 months old—crossed with a male of like age—giving birth to a litter of one.

4. *Period of gestation.* The gestation period of the non-lactating albino rat is usually stated to be about 21–22 days. In the cases where the gestation period has been exactly recorded in our colony the exact time of copulation and of birth having been observed, Stotsenburg (MS '14) has found it to be from 21 days and 15 hours to 22 days and 16 hours.

Lengthening of gestation period. King ('13), makes the following statements which apply to lactating Albinos, maintained on a mixed diet.

The gestation period in lactating albino rats is of normal length if the female is suckling five or less young and is carrying five or less young.

The gestation period may be prolonged from one to six days if an albino female, suckling five or less young, is carrying six or more young.

The period of gestation is always prolonged when a female is suckling six or more young. In these cases the number of young in the second litter seems to have less influence on the length of the gestation period than has the number of young suckled; but if both litters are very large the gestation period may be extended to 34 days.

5. *Superfecundation and superfetation.* Superfecundation occurs occasionally in the albino rat and causes an interval of two, three or more days between the birth of different members of the litter (King, '13).

In support of this statement the following instances are cited:

1) Litter born October 27, 1911; examined November 10, 1911, 12 individuals—11 of these weighed about 14 grams each. The remaining one had very little hair, weighed 7.1 grams and appeared 4–5 days old.

2) Litter born December 20, 1911; examined January 2, 1912, 10 individuals—9 of like size weighed 16–17 grams each. The remaining one small; hair just appearing; weighed 10.8 grams.

3) Litter born February 26, 1912; examined March 11, 1912, 10 individuals—3 had their eyes open and weighed 10.1–10.5 grams. The remaining seven were apparently but one or two days old and weighed 4.2 grams on the average.

In rare instances ovulation takes place in the albino rat during pregnancy and superfoetation occurs. In two cases of this kind litters have been produced at intervals of about two weeks (King, '13, pp. 388 and 389).

6. *Fecundity and weight at birth.* At the beginning of ovulation in the albino rat Sobotta and Burckhard ('10) find on the average a total of thirteen ova in both fallopian tubes. The largest litter we have noted in the common Albino contained sixteen. One instance also of sixteen fetuses 18 days old has been observed Stotsenburg (MS '15).

Kolazy ('71) reports litters consisting of 5–17 young. Crampe ('84) records for 2503 young represented by 394 litters, an average of 6.3 per litter. From 1911–1913, 275 litters (1928 individuals) in our colony gave an average of 7.0 individuals per litter, and in 1914, 814 litters (5691 individuals) gave an average of 6.99 individuals per litter. Litter size does not appear to be influenced by season (King and Stotsenburg, '15).

Under certain food conditions the size of the litters is much modified. When an exclusive diet of ox flesh is given to Albinos—2–4 months of age at the beginning of the experiment—and these are compared with control rats fed on bread and milk, Chalmers Watson ('06 a) finds in the meat fed Albinos pregnancy less frequent, the weight of the mammae less, and the average number of young in a litter, as well as the average weight of the young, both smaller than in the controls. Such an exclusive meat diet is therefore unfavorable both for breeding and for early growth. On the other hand, Stotsenburg (MS '15) found that mothers fed on a table scrap diet produced a larger number of fetuses than those fed on bread and milk.

As to the size of the litters at different periods in the life of the female, there are a few observations. Lloyd ('09 a) in his studies on two strains of the house rat, published tables which he interpreted to mean that the number of individuals in a litter was independent of the body weight of the mother. Pearson ('10) however was able to show from Lloyd's data that in both groups the number in a litter increased with the body weight of the mother.

It seems probable however that the heavier rats were also older, as Pearson suggests, and that the proper interpretation of the increase in the size of the litter is to relate it with the age of the mother. In these groups none of the animals were beyond the prime of life and hence the explanation is very probably correct.

There is now available some detailed information on the relation between the weight and age of the mother and the characters of the young.

A study of 11 litters of common albino rats containing 91 young bred by King (MS '15) at The Wistar Institute, gives

the average individual birth weight for the male as 4.72 grams and for the female 4.56 grams.

The data from these 11 stock litters used for tables 3, 4, 5, 6 have not been published elsewhere in a separate form. In the paper by King ('15), however these data are combined with corresponding data for the inbred Albinos to form similar tables. The results obtained from the stock data here given are quite in agreement with those from the combined data of King ('15). The birth weight may be modified by a series of conditions as shown in the following tables.

TABLE 3.

Influence of the age of the mother on birth weight

NUMBER OF MOTHERS	MOTHER		AVERAGE WEIGHT—INDIVIDUALS	
	Body weight	Age in days	Males No.	Females No.
	gms.			
(4)	165	114	4.50 (12)	4.52 (20)
(3)	201	143	4.52 (14)	4.49 (14)
(4)	225	217	4.97 (18)	4.81 (13)

Table 3 shows that with increasing age up to 217 days the individual birth weight increases with the age of the mother. At the same time it is to be seen that the body weight of the mother also increases.

When the same data are arranged according to the bodyweight of the mother, we get the relations shown in table 4.

TABLE 4

Influence of weight of mother on birth weight

NUMBER OF MOTHERS	MOTHER		AVERAGE WEIGHT—INDIVIDUALS	
	Body weight	Age in days	Males	Females
	gms.			
(4)	165	114	4.53 (12)	4.40 (20)
(3)	200	150	4.65 (14)	4.55 (16)
(4)	226	211	4.88 (18)	4.76 (11)

Here the birth weight increases with the increasing bodyweight, but the age is also increasing in the successive groups. The influence of the size of the litter on birth weight does not

give regular results, but if we take the extreme records, we find that in the small litters of 6.5 the individual birth weight is higher than in the large litters of 10 or more (table 5).

The failure to get regular results is probaby due to the small number of cases here used.

TABLE 5

The influence of the size of the litter on the individual birth weight

NUMBER OF MOTHERS	MOTHER			AVERAGE WEIGHT—INDIVIDUALS	
	Body weight	Age in days	No. in litter	Males	Females
	gms.				
(4).............	195	165	6.5	4.99 (14)	4.65 (12)
(3).............	199	149	8.3	4.56 (13)	4.42 (12)
(4).............	195	139	10.0	4.60 (17)	4.53 (23)

Finally, if we take the individual birth weights as the criterion and compare the birth weights under 4.5 grams (for the male) with the birth weights of 5 grams or more (for the male) it appears that the heavier birth weights are associated with the heavier weight of the mother—as we should expect from table 4. At the same time it is to be noted that the age at which the heavier birth weights are recorded is greater.

TABLE 6

The individual birth weight in relation to body weight of mother

NUMBER OF MOTHERS	MOTHER		AVERAGE WEIGHT—INDIVIDUALS	
	Body weight	Age in days	Males	Females
	gms.			
(6).............	179	133	4.37 (23)	4.28 (28)
(3).............	201	144	4.96 (13)	4.80 (14)
(2).............	244	263	5.31 (8)	5.26 (5)

These relations exhibited by table 6 and based on this small number of stock Albinos agrees with those already determined by King on a much larger series which combines the data here used with a large series of litters from inbred Albinos.

This agreement shows that in these respects there is no significant difference between the stock Albinos and the inbred strain

of King. The general conclusion which King reaches is that increasing weight or increasing age of the mother (the two being correlated) give a heavier birth weight, while the increase in the number in a litter tends to diminish the individual birth weight. There is to be observed also a diminution in birth weight in those litters born of mothers below the standard in size, or suffering from infectious disease. With the larger material just mentioned, it is also possible for King and Stotsenburg ('15) to show a modification of the birth weight in relation to the place of the litter in the series of litters born by a given female, see table 7.

TABLE 7

Showing the sex ratios and average number of young in 75 litters of stock albino rats. Data arranged according to the position of the litters in the litter series

LITTER SERIES	NUMBER OF LITTERS	NUMBER OF INDIVIDUALS	MALES	FEMALES	NUMBER MALES TO 100 FEMALES	AVERAGE NO. YOUNG PER LITTER
1	21	131	72	59	122.0	6.2
2	21	162	85	77	110.4	7.7
3	18	127	64	63	101.6	7.0
4	15	96	41	55	74.5	6.4
	75	516	262	254	102.1	6.8

The observations indicate that the number of individuals in the litter generally increases from the first to the second litter, and after that decreases. These results would quite accord with Crampe's conclusions. According to Crampe ('84) the second litter of albino rats is the best. The majority of albino females do not produce more than four or five litters.

7. *Recognition of sex.* The recognition of sex through external characters in the young rat has been studied by Jackson ('12). He finds in brief that the male, as contrasted with the female, may be recognized by (1) The larger size of the genital papilla; (2) the greater ano-genital distance (see table 8); (3) the absence of clearly marked nipples. (This test is applicable only up to the age of 16 days, i.e., before the development of hair on the ventral surface.) (4) Small extent of the bare area just ventral to the anus (test applicable only after the 16th day).

As a rule the descent of the testes occurs about the fortieth day of age or somewhat earlier. The following is a condensed form of Jackson's table for the ano-genital distance.

TABLE 8

Ano-genital distance in young albino rats of various ages

AGE	NUMBER OF EACH SEX		AVERAGE GROSS BODY WEIGHT		AVERAGE ANO-GENITAL DISTANCE	
	Male	Female	Male	Female	Male	Female
			gms.	*gms.*	*gms.*	*gms.*
New born......	10	12	5.7	5.4	2.8	1.2
7 days.........	17	26	11.0	10.4	5.2	2.7
14 days........	13	15	19.5	18.2	8.2	4.9
20 days........	19	26	27.4	27.4	12.0	7.0
42–50 days.....	19	13	73.3	71.0	21.0	13.0

8. *Sex ratio.* On the basis of 30 litters comprising 255 individuals, Cuenot ('99) reports among albino rats—when the litters are examined shortly after birth—105.6 males to each 100 females.

King ('11 b) in 80 litters containing 452 individuals, found 107.3 males to 100 females, and in a later series of 120 litters (which includes the 80 litters just mentioned) containing 690 individuals, a sex ratio of 107.8 males to 100 females. Finally, in a group of 814 litters, comprising 5691 individuals, King and Stotsenburg ('15) found 108.1 males to 100 females.

In a thriving colony therefore a ratio of about 108 males it to be expected. This however is subject to a seasonal variation. At the two periods of greatest reproductive activity—in the spring (March–May) and again in the autumn (September–November) the proportion of males (the sex ratio) is low.

In the first litters of young females the sex ratio tends to be higher than in the later litters—but no relation of sex ratio to size of litter has been found (King and Stotsenburg, '15).

9. *Body weight according to sex—at maturity.* At maturity the body weight of the male Albino is much greater than that of the female. According to our records for the common strain—ages not known—the four largest males thus far examined weighed 320, 327, 343 and 438 (fat) grams respectively, and the four largest females 280, 287, 319 and 359 (fat) grams. In Albi-

nos of the common strain, the following maximum weights for each sex at known ages have been observed by King (MS '15).

TABLE 9

Body weight in grams

AGE IN DAYS	MALES	FEMALES
395		284
425	397	
455	409	
485	437	{265 324

10. *Behavior.* a) The normal activities of the rat under natural conditions have been studied and described by a number of observers (see references).

b) As the albino rat is easily tamed and responds readily to training it has already been used for a number of studies in which behavior tests have been employed. Studies have been made for example on imitation, temperament, the influence of practice, retentiveness, the rôle of the several organs of sense and the relation of the learning rate to age and to the relative brain weight (see references).

BIOLOGY: REFERENCES

Life history. Donaldson, '08. King, '13. Kirkham, '10. Kirkham and Burr, '13. McCoy, '09. Slonaker, '07, '12. Stewart, 1898. Watson, '03.

Span of life. Donaldson, '08. Slonaker, '12, '12 a.

Puberty, Ovulation, Menopause. Hewer, '14. Kirkham and Burr, '13. Sobotta and Burckhard, '10.

Period of gestation. King, '13.

Superfecundation. King, '13.

Fecundity and weight at birth. Crampe, '84. King, '15. King and Stotsenburg, '15. Kolazy, 1871. Lloyd, '09 a. Pearson, '10. Sobotta and Burckhard, '10. Watson, '06 a.

Recognition of sex. Jackson, '12.

Sex ratio. Cuenot, 1899. King, '11 a, 11 b. King and Stotsenburg, '15.

Body weight according to sex. King and Stotsenburg, '15.

Behavior. a) Under natural conditions. Advisory Committee, '12. Bechstein, 1801. Bell, 1837–1874. Buckland, 1859. Buffon, 1749–1789. Dehne, 1855. Fisher, 1872. Hewett, '04. Kolazy, 1871. Lambert, '10. Lantz, '10. Manouvrier, '05. Mitchell, '11. *b) Under experimental conditions.* Adams, '13. Basset, '14. Berry, '06. Carr and Watson, '08. Cesana, '10. Hubbert, '14, '15. Hunter, '12, '13. Lashley, '12. Richardson, '09. Small, 1899, 1900, '01. Szymanski, '14. Ulrich, '13. Vincent, '12, '13, '15, '15 a, '15 b. Watson, J. B., '03, '07, '13, '14.

CHAPTER 2

HEREDITY

1. General.—2. Coat color

Inbreeding brother and sister from the same litter of Albinos for twenty successive generations (King, 1911–1915, MS) has not been followed by any physical deterioration.

Studies on heredity in the Norway rat have been concerned mainly with the inheritance of coat color. The gray coat of the wild Norway is dominant in crosses between the wild gray and the Albino. The Albinos in the F_2 generation appear in the proportion of one Albino to three pigmented. In the F_2 and in the later generations pied animals may be had and the color pattern both fixed and modified by selection (Castle, '12, 12 a, and Castle and Phillips, '14). The inheritance of brain weight in the reciprocal crosses Norway × Albino has been studied by Hatai (MS '13).

The references to the literature are grouped into 1) those touching the general problem and 2) those especially applying to coat color.

HEREDITY: REFERENCES

1. *General.* Castle, '11, '12, '12 a. Castle and Phillips, '14. Crampe, 1883, 1884. Darwin, 1883. Hagedoorn, '11, '14. Hatai, '11 a, '12. Lloyd, '08, '09, '11. Pearson, '11. Przibram, '07, '10, '11. Ritzema-Bos, 1894. Yerkes, '13.

2. *Coat color.* Bateson, '03. Castle, '14 a, '14 b. Castle and Phillips, '14. Crampe, 1877. Doncaster, '06. Fischer, 1874. Frédéric, '07. Haacke, 1895. MacCurdy and Castle, '07. Morgan, '09. Mudge, '08, '08 a, '09.

CHAPTER 3

ANATOMY

1. Anatomy, general. 2. Embryology. a) Spermatogenesis. b) Ovulation. c) Earlier stages. d) Later stages. 3. Bones, joints and connective tissues. a) Teeth. 4. Muscles. 5. Vessels and lymphatics. a) Blood. 6. Nervous system. a) Central *1*) Brain. *2*) Spinal cord. b) Peripheral. *1*) Cerebral. *2*) Spinal nerves and ganglia. 3) Autonomic. c) Technical methods. 7. Sense organs. 8. Integument. 9. Gastro-pulmonary system. a) Gastro-intestinal system. b) Pulmonary system. 10. Uro-genital system. 11. Endocrine system.

Since this book purposes to present mainly those results that can be systematically arranged and are in a quantitative form —there will appear several divisions of this chapter marked only by references to the literature.

Further, even in those divisions for which there are some available data it happens in many instances that the presentation of them can be better given in the chapters which treat of growth —and in such instances the reader is merely referred to the later place of presentation. These general statements apply to the subsequent chapters as well.

1. *Anatomy, general.* In only two instances has the rat been used as the basis for a general presentation of mammalian anatomy. These are in the books by Martin and Moale, 1884, and Goto, 1906. The remaining references are to studies which apply to portions or systems only (see classified references—at the end of the chapter).

2. *Embryology, a) Spermatogenesis.* According to Hewer ('14):

In the newborn animal, active mitosis is occurring in the testis, and at 3½ weeks the spermatogonia can be distinguished from the spermatocytes. No lumen begins to appear in the tubules as a rule until 7 weeks. At 8 weeks spermatids are easily distinguishable: at 8½ weeks isolated spermatozoa may occasionally be seen. At 9 weeks typical ripe spermatozoa are plentiful, but the fully formed epididymis contains no free spermatozoa. At 10 weeks all the tubules show active

spermatogenesis: the second crop of spermatozoa is appearing, while the first crop can be seen in the epididymis. Reduced number of chromosomes 19. Allen (MS '15).

b) Ovulation. According to the observations of Sobotta and Burckhard, '10, ovulation is simultaneous in both ovaries—as many as 13 egg cells have been found discharged. The ovum—after fixation with Zenker's solution containing somewhat less than the usual proportion of acetic acid—measured 60–65 μ in diameter with a nucleus about 25 μ in diameter. The reduced number of chromosomes is 16. The full number of chromosomes 32. The authors incorrectly assume that the common Albino is a variety of Mus rattus.

For the diameter of the living unsegmented egg Kirkham and Burr ('13) give 79 μ as a mean value.

For the volume of the ovum see table 11.

c) On the early stages of development we have the observations of Huber ('15 a). His description is as follows:

The material at hand permits the conclusion that in the albino rat the segmenting ova pass from the oviduct to the uterine horn at the end of the fourth day after the beginning of insemination, probably in the 12-cell to 16-cell stage. With the beginning of the fifth day, as will appear from further discussion, all of the ova are to be found in the uterine horn.

The following summary of the data gained by a study of the models of oviducts containing ova in stages from the pronuclear to 12-cell to

TABLE 10

Showing the distance of the ova from the fimbria at various ages. Based on table 3, Huber ('15a)

RECORD NUMBER	SIDE RECONSTRUCTED	AGE	NUMBER OF OVA	STAGE	LENGTH OF OVIDUCT	DISTANCE OF OVA FROM FIMBRIA	RELATIVE LENGTH OF TUBE TRAVERSED.
					cm.	*cm.*	
106..........	R.	1 day	8	Pronuclear	3.2	0.8	0.25
59..........	R.	2 days	4	2-cell	2.29[1]	1.4	0.63
62..........	L.	2 days 22 hrs.	5	2-cell	2.45[1]	2.0	0.84
50..........	R.	3 days 1 hour	4	4-cell	2.8	2.5	0.90
51..........	L.	4 days	5	12 to 16 cell	2.86	2.86	1.00

[1] Not the entire length of oviduct was available for reconstruction.

16-cell stages in which latter stage transit to the uterine horn occurs, is presented to indicate rate of transit within the oviduct. The regularity of the rate of transit as revealed in the summary may perhaps speak for the trustworthiness of the age data as concerns my material.

It will be observed that the ova approach the uterine end of the oviduct while in the 2-cell stage (see table 10); transit through the last portion of the oviduct, where the greater part of the segmentation occurs, being relatively slow. It is hoped that these data, for the accuracy of which I am dependent on reconstructions, may be of service to others who may desire to collect segmentation stages of the albino rat.

In order to obtain the volume changes of the ova during transit through the oviduct, beginning with the pronuclear and extending to the 8-cell to 11-cell stages, reconstructions were made at a magnification of 1000 diameters of ova presenting the stage in question. The respective volumes of these models were determined and the data reduced to the actual volumes.

TABLE 11

Volumes of ova and embryos. Based on table 4 Huber ('15 a)

RECORD NUMBER	AGE		STAGE	ACTUAL VOL. OF EGG MASS IN C. MM.	AVERAGE VOL. PER STAGE GIVEN IN C. MM.
	Days	Hours			
106..........	1	0	Pronuclear	0.000151	0.000156
106..........	1	0	Pronuclear	0.000143	
106..........	1	0	Pronuclear	0.000158	
106..........	1	0	Pronuclear	0.000171	
59..........	2	0	2 cell	0.000162	0.000173
59..........	2	0	2 cell	0.000183	
50..........	3	1	4 cell	0.000183	0.000162
50..........	3	1	4 cell	0.000155	
57..........	3	17	8 cell	0.000189	0.000184
57..........	3	17	8 cell	0.000160	
57..........	3	17	8 cell	0.000187	
57..........	3	17	8 cell	0.000182	
57..........	3	17	8 cell	0.000200	
57..........	3	17	11 cell	0.000210	0.000210

The uniformity of the figures giving the actual volume of the egg mass, as determined by the weight of the water displaced by the models of the respective ova reconstructed, leads me to feel that the errors committed in reconstruction were not serious. The last column of the table, giving averages, is of interest since it shows a very slight increase in the volume of the egg mass during segmentation and transit through the oviduct. Following the pronuclear stage, which, as has been seen, extends through a relatively long period and into the beginning of the second day, by which time the ova have migrated about one-fourth of

the length of the oviduct, there occurs only three successive mitotic divisions, including the first segmentation division, namely mitoses resulting in 2-cell, 4-cell, and 8-cell stages while the ova are in transit in the oviduct. In making this statement it is assumed that in the successive segmentations, the several cells divide synchronously, which is not in conformity with the fact. These three mitotic divisions are spaced at intervals of about 18 hours.

In the next following division, the fourth, the ovum passes from the oviduct to the uterine horn. Since the normal gestation period of the non-lactating albino rat is only 21 to 23 days, this slow rate of increase in volume and multiplication of cells during the first four days of development is of especial interest and is very probably to be accounted for by the inadequacy of the food supply of the ovum during its transit through the oviduct.

d) Later stages. Observations have been made by Stotsenburg (MS '15) on the daily increase in the weight of the fetus from the 13th to the 22nd day after insemination. The data and graph are given in chapter 5, pp. 64 and 65.

3. *Bones, joints and connective tissues.* On the following page is an enumeration of the bones forming the skeleton of the rat.

For data on the growth of the entire skeleton see Chapter 6.

Skull measurements have been made by Hatai ('07 c). The following description is extracted from his paper.

For this study 53 male and 51 female skulls of mature Albinos (rats more than 150 days old) were measured. These skulls had been carefully cleaned and dried at room temperature. The following measurements were made with vernier calipers: 1) the length of the entire skull; 2) the fronto-occipital length; 3) the zygomatic width; 4) the length of the nasal bone; 5) the height of the skull; 6) the width of the cranium or the squamosal distance. In every case the maximum length alone was recorded in millimeters.

The horizontal straight line joining the tip of the nasal bone to the end of the occipital bone is called the length of the entire skull. This however is not exactly equal to the sum of the length of the nasal bone and that of the fronto-occipital.

The fronto-occipital length was determined in the following way: Since the length measured with the calipers from the tip of the nasal bone to the posterior end of the inter-parietal bone is usually less than the length measured from the same point to the end of the occipital bone, both measurements were taken (see fig. 1). The difference between these two measurements was added to the length from the tip of the frontal bone to the end of the inter-parietal bone, and the sum was called the fronto-occipital length.

The width of the cranium (squamosal distance) was determined by

LIST OF BONES

Skull	Cranium	Nasals	2
		Premaxillae	2
		Maxillae	2
		Jugals	2
		Palatines	2
		Vomer	1
		Lachrymals	2
		Ethmoid	1
		Frontals	2
		Sphenoid	1
		Presphenoid	1
		Parietals	2
		Squamosals	2
		Interparietal	1
		Occipital	1
		Periotic capsules	2
		Tympanic bones	2
		Ear bones: Malleus	2
		Ear bones: Incus	2
		Ear bones: Stapes	2
	Mandible		2
	Teeth		16
Hyoid			1
Vertebrae	Cervical		7
	Dorsal or thoracic		13
	Lumbar		6
	Sacral		4
	Caudal	(about)	30
Ribs	Vertebro-sternal		14
	Vertebro-costal		6
	Vertebral		6

Sternum		6
Shoulder girdle	Scapula	2
	Clavicle	2
Pelvic girdle	Ilium	2
	Ischium	2
	Os pubis	2
Humerus		2
Ulna		2
Radius		2
Fore feet	Carpus	16
	Metacarpus	10
	Phalanges	28
Femur		2
Tibia		2
Fibula		2
Sesamoid bones	Patellae	2
	2 back of Femur	4
Hind feet	Tarsus	16
	Metatarsus	10
	Phalanges	28
		281

Nails (20) omitted

taking the maximum distance between the two points (right and left) where the zygomatic bones rest on the lateral walls of the cranium. The height of the skull was determined by measuring a perpendicular distance between the greatest convexity of the parietal bone in the median line and the junction line between the basi-occipital and the basisphenoidal bones on the ventral surface.

The cranial capacity was determined in the following way: The skull was held vertically, with the nose downwards and was filled with fine shot (no. 11) to the upper level of foramen magnum and then the nose of the skull gently struck twice against the palm of the hand.

The space thus formed was again filled. Although this is a simple procedure yet it needs the greatest care to produce uniform results.

TABLE 12

Giving the mean values for several measurements on the cranium, together with the standard deviation and the coefficient of variation and the respective differences. Based on table 1. Hatai ('07c)

			MEAN		STANDARD DEVIATION		COEFFICIENT OF VARIATION		NO. OF RATS
				Difference		Difference		Difference	
In millimeters	Length of the entire cranium....	♂	43.255±0.166	1.706±0.204	1.786±0.117	0.530±0.144	4.129±0.271	1.113±0.338	53
		♀	41.549±0.119	3.944%	1.256±0.084		3.016±0.202		51
	Zygomatic width................	♂	21.745±0.109	0.820±0.137	1.177±0.077	0.301±0.064	5.412±0.356	1.226±0.453	53
		♀	20.925±0.083	3.771%	0.876±0.059		4.186±0.280		51
	Length of the nasal bone........	♂	16.958±0.096	1.266±0.122	1.038±0.068	0.245±0.086	6.121±0.403	1.068±0.526	53
		♀	15.962±0.075	7.465%	0.793±0.053		5.053±0.338		51
	Fronto-occipital length..........	♂	27.264±0.093	0.911±0.126	1.007±0.066	0.103±0.090	3.693±0.242	0.256±0.334	53
		♀	26.373±0.085	3.341%	0.904±0.060		3.427±0.229		51
	Squamosal distance.............	♂	15.273±0.010	0.217±0.040	0.338±0.022		2.213±0.145		53
		♀	15.056±0.039	1.420%	0.409±0.027	−0.071±0.036	2.716±0.181	−0.503±0.232	51
	Height of cranium..............	♂	11.493±0.049	0.354±0.065	0.526±0.034	0.151±0.043	4.576±0.300	1.210±0.375	53
		♀	11.139±0.035	3.080%	0.375±0.025		3.366±0.225		51
	(Length x width x height)$^{\frac{1}{3}}$......	♂	16.875±0.044	0.452±0.056	0.478±0.031	0.096±0.040	2.832±0.186	0.506±0.242	53
		♀	16.423±0.036	2.678%	0.382±0.026		2.326±0.155		51
Cranial capacity in gms. of shot.....		♂	10.896±0.068	0.528±0.098	0.735±0.048		6.745±0.444		53
		♀	10.368±0.070	4.845%	0.743±0.050	−0.008±0.069	7.166±0.481	−0.421±0.655	51
Body-weight in gms.................		♂	214.886±5.318	47.541±5.982	52.887±3.760	32.413±4.088	25.076±2.675	12.841±2.847	45
		♀	167.345±2.739	22.170%	20.474±1.605		12.235±0.974		37

By practice Hatai has been able to reduce the difference between the first and second filling to less than one per cent. The cranial capacity thus determined in the terms of shot weight can be transformed into brain weight as follows: by dividing the weight of the shot in the case of the males by 5.980 and in the case of the females by 6.009. The relations between the cranial capacity, in terms of shot weight, and the body weight are represented by the formulas (8) and (9).

TABLE 13

Showing the range of variates and rate of increase for various characters according to sex Hatai ('07 c)

	MALE			FEMALE		
	Minimum	Mean[1]	Maximum	Maximum	Mean[1]	Minimum
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Length of the entire cranium	39.4	43.3	47.4	44.5	41.5	38.9
Rate	100	100	100	100	100	100
Zygomatic width.	19.6	21.7	24.8	23.4	20.9	18.9
Rate	49.8	50.2	52.3	52.5	50.3	48.5
Length of the nasal bone.	14.7	17.0	18.7	17.8	15.7	14.4
Rate	37.3	39.2	39.3	40.0	37.7	37.0
Fronto-occipital length.	24.9	27.3	28.8	28.2	26.4	24.9
Rate	63.2	63.0	60.7	63.3	63.5	64.0
Squamosal distance.	14.6	15.3	16.2	16.2	15.1	14.4
Rate	37.0	35.3	34.1	36.4	36.2	37.0
Height of cranium	10.4	11.5	13.0	12.2	11.1	10.3
Rate	26.4	26.5	27.4	27.4	26.8	26.4

[1] Taken from Table 12.

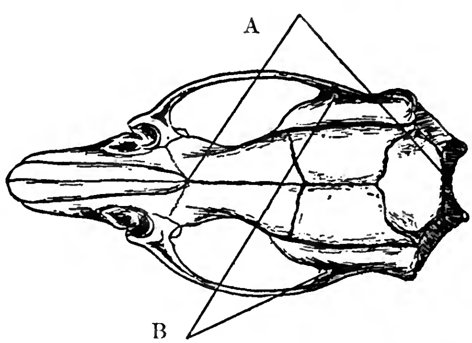

Fig 1. A. Fronto—occipital length. B. Squamosal distance.

The greatest difference found between the measurements of the skulls for the two sexes is in the nasal bones, which are nearly 2 per cent longer in the male skull. The greater relative length of the nasal bones in the male may be regarded as a secondary sexual character (Hatai).

a) *Teeth.* Addison and Appleton ('15) report as follows on the size and growth of the incisor teeth in the Albino.

The dental formula of the albino rat is

$$\mathrm{I}\frac{1}{1}\ \mathrm{C}\frac{0}{0}\ \mathrm{P}\frac{0}{0}\ \mathrm{M}\frac{3}{3}$$

There is only one set of teeth, and hence the dentition is monophyodont. The time of eruption of the various teeth extends over a period of $3\frac{1}{2}$ weeks. The incisors are the first to appear, viz., at 8 to 10 days after birth. The first and second molars erupt at about the 19th and 21st days respectively, and it is after this latter period that the young animals may be weaned and are able to maintain an independent existence, as far as food is concerned. The third molars are delayed until two weeks later and do not appear until about the 35th day.

The incisors are permanently-growing (or rootless) teeth, while the molars have a definite limited period of development and acquire roots. A wide diastema separates the incisors from the molars as may be seen by reference to figure 1 (loc. cit.) The incisors are strongly curved and Owen (1840–1845) has described the lower incisor as being the smaller segment of a larger circle, and the upper incisor as the larger segment of a smaller circle. In the case of lower incisor of the albino rat this statement needs a slight modification.

The times of the early stages of development of the incisors were as follows:

14 day fetus—slight thickening of oral epithelium.
15 day fetus—distinct thickening and growth inwards of oral epithelium.
16 day fetus—dental ledge and beginning of flask-shaped enamel organ.
17 day fetus—dental papilla with crescentic enamel organ capping it.
19 day fetus—both ameloblasts and odontoblasts differentiated.
New-born animal—enamel and dentine formation begun.
8 to 10 days—eruption of the tooth.

The rate at which the teeth increase in length during their formative period and prior to attrition is given in the following table:

TABLE 14

	Length of incisors	
	Upper	Lower
	mm.	*mm.*
1 day old	2.3	3
4 days old	3.6	5
7 days old	5	7–8
10 days old	7	11

Average growth of upper incisor 0.52 mm. and of lower incisor 0.88 mm. per day.

TABLE 15

	Incisors	
	Upper	Lower
	μ	μ
Total thickness	100–110	140–150
Outer fibrous layer	30–40	20–30
Pigmented portion of outer fibrous layer	8–10–12	6–8
Inner plexiform layer	70	120–125

TABLE 16

	23 days	41 days	10 weeks	15 weeks	5 months	8 months	10 months
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Naso-occipital length	29.7	32.5	39	40	43	44	46.5
Interzygomatic[1]	13.7	14	14.5	14.6	15.4	15.1	15.5
Upper diastema	7.4	9.5	10	11.4	12.3	12.5	13
Upper incisor—total length	12.8	15	18.3	20.3	23.3	23.7	26.2
Upper incisor—extra alveolar length	5.1	5.5	7	8.4	8.7	9	9.3
Lower diastema	4.6	5	5.6	6	6.7	7	6.8
Lower incisor—total length	18.1	21.7	25.5	26.4	29.4	29.9	31.3
Lower incisor—extra alveolar length	6.5	7	10.5	11.4	11.6	12	12.4

[1] Same as 'squamosal distance,' figure 1, p. 36.

Throughout life growth continues, and in the adult animal is on the average 2.2 mm. per week in the upper and 2.8 mm. per week in the lower incisor.

In a five months animal the thickness of the enamel and its constituent layers measured in the mid-line of the teeth is given in table 15.

Measurements of the incisors and skulls of animals of different ages were made and are shown in table 16.

The lower incisor of a five months animal forms a segment of about four-fifths of a semicircle (140–145°).

4. *Muscles.* Morpurgo (1898) has furnished data on the Musc. radialis of the albino rat; giving the number of muscle fibers and of nuclei at different ages (table 17).

TABLE 17

AGE	NO. OF MUSCLE FIBERS	NO. OF NUCLEI PER CUBIC MM.	AREA OF CROSS SECTION IN MM. X 37 DIAM.
Newborn	5919	570645	552
15 days	7252	357764	868
16 days (very well grown)	7587	347343	1010
30 days	7625	139861	2766
420 days	8014	37542	11817

5. *Vessels and lymphatics.* *a) Blood.* Specific gravity 1.056 (Sherrington and Copeman, 1893). The diameter of the erythrocytes is as follows (White, '01):

FOR M. DECUMANUS	DIAMETERS IN μ
Determination by (Treadwell)	6.5
Determination by (Wormley, 1888)	7.0
Determination by (Gulliver, 1875)	6.5

1) Percentage of water in the blood. Hatai (MS '15) has determined the percentage of water in the blood of a small series of Albinos.

The Albinos were from The Wistar Institute stock strain, grown on the scrap diet and examined before the day's feeding. The rat was chloroformed, but before the heart ceased beating it was exposed in situ, the tip clipped away and the blood from it caught in a small glass weighing bottle. The fresh weight was immediately taken and after drying at 95°C. for a week the weight of the residue was obtained.

The results are given in table 18.

TABLE 18

Percentage of water in the blood of the Albino, Hatai (MS. '15)

SEX	NO. OF CASES	BODY WEIGHT RANGE	MEAN	PERCENTAGE OF WATER IN BLOOD	
				Range	Mean
			gms.		
M	4	106–127	121	79.47–81.05	80.09
M	4	135–194	157	79.05–81.15	80.00
F	5	72–100	88	78.13–81.12	79.88
F	6	105–125	117	80.25–80.97	80.30

In 50 rats (27 males + 23 females) between the weights of 50 and 150 grams the average number of erythrocytes was found by Chisolm ('11) to be 8.8 millions and the average hemoglobin content 87.8 per cent as measured on the human scale.

TABLE 19

Rivas (University of Pennsylvania MS. '14). Observations on the Albino rat blood—normal.

PERCENTAGE OF HEMOGLOBIN	IN 1 CU. MM.		PERCENTAGES OF				
	Erythrocytes in millions	Leucocytes	Polymorph.	Small lymph.	Large lymph.	Eosinoph.	Basoph.
85	8.6	8,800	68.5	24.9	6.2		
85	9.2	7,200	56.5	34.4	9.1	0.4	0
88	8.2	8,400	47.5	44.9	5.9	3.0	0.85
90	7.4	8,000	44.9	49.3	5.2	0.9	0
90	8.0	8,000	69.9	25.4	4.2	0.7	0.70
90	8.4	9,400	42.4	50.5	4.0	0.0	0
93	8.4	16,000	43.6	51.9	4.3	0.5	0.26
95	7.6	11,600	71.6	20.7	4.1	0.6	0
97	7.6	8,800	56.4	37.6	4.5	1.5	0
100	8.4	9,400	51.2	42.1	6.2	0.7	0

In addition the observations of Rivas, University of Pennsylvania (MS '14) are given in table 19. The data are arranged according to the increasing haemoglobin content.

For the wandering cells we have tables 20 and 21 by Kanthack and Hardy, 1894.

TABLE 20

Showing the percentage and size of the various forms of the wandering cells of the blood in the rat

TYPE OF CELL	GRANULATION	PERCENTAGE OF TYPE	DIAMETERS IN μ
Oxyphile	Coarse	2	10
	Fine	45	7–8
Basophile	(absent)		
Hyaline		2	8–10
Lymphocytes		50	6

TABLE 21

(From the same authors)

Shows the percentage and size of various forms of the wandering cells in the peritoneal fluid of the rat

TYPE OF CELL	GRANULATION	PERCENTAGE OF TYPE	DIAMETERS IN μ
Oxyphile	Coarse	20–40	10
	Fine	(absent)	
Basophile[1]	Coarse	5–10	18
	Fine	(absent)	
Hyaline		65–80	13
Lymphocytes			6.5

[1] Basophile cells in connective tissue 23 μ in diameter.

6. *Nervous system. a) Central. 1) Brain.* Specific gravity 1.050–1.056, Reichardt ('06). For brain weight see Chapter 7, p. 90, and table 68. For the percentage of water see Chapter 8, p. 176 and table 74. For the chemical composition see Chapter 9, p. 181 and tables 80, 81. Cell division in the central nervous system continues after birth. The observations of Hamilton ('01) are given in table 22.

TABLE 22

The number of mitoses in 13 consecutive sections, each section 6.75 μ in thickness, from the brain and spinal cord of rats at different stages of development. The fetus weighed 0.78 gms. and had a crown-rump length of 17 mm. It was probably at 17.5 days of gestation.

STAGE OF DEVELOPMENT	BRAIN	
	Ventricular mitoses	Extra-ventricular mitoses
Foetus	2196	966
Birth	390	595
24 hours	24	386
4 days	115	443
	LUMBAR CORD	
	Ventricular mitoses	Extra-ventricular mitoses
Foetus	28	18
Birth	8	45
24 hours	1	13
4 days	8	64

For the first 25 days after birth Allen ('12) has obtained the results given in table 23.

TABLE 23

Showing the number of mitoses per cubic millimeter of nerve tissue in the central nervous system of the stock Albino at certain levels. The figures are taken from calculations of the volume of tissue and based on the number of mitoses in the consecutive sections at each level of the cord, five in the largest portion of the cerebellum and five in the cerebrum in the region of the optic chiasma. The letters (a) (b) and (c) refer to different rats of the same age

AGE, DAYS	CORD			CEREBELLUM	CEREBRUM
	Cervical	Thoracic	Lumbar		
1	208	115	259	*1597*	430
4	437	176	351	*2111*	447
6	446	236	320		193
7				*4848*	
12	46	75	14	839	37
20	*00*	*00*	*00*	(c) *520*	
20	00	00	00	(b) 61	(b) 27
20	*00*	*00*	*00*	(a) 00	(a) 18
25	00	00	00	00	27

The diameters of the Purkinje cells have been studied by Addison, '11.

The Albinos were from the stock colony of The Wistar Institute, reared on the scrap diet. The cerebellum was fixed in Ohlmacher's solution (King, '10) imbedded in paraffin and stained with carbol-thionine and acid fuchsin. The values for the respective diameters given in table 24 are in each instance averages of ten measurements from the largest cells found in equivalent areas at the several ages. The measurements stop at 20 days of age. After this age there is but little change in the diameters of the largest cells.

TABLE 24

Diameters of Purkinje cells and their nuclei

AGE IN DAYS	DIAMETERS IN μ	
	Cell	Nucleus
Birth	12 × 7	8 × 6.3
3	14 × 8	8.3 × 7.4
8	18 × 12	11 × 8.5
10–20	21 × 14	12 × 9.0
	(largest) 24 × 19	

2) Spinal cord. For the weight of the spinal cord see Chapter 7, p. 90, and table 68. For the percentage of water see Chapter 8, p. 176, and table 74. For the chemical composition see Chapter 9, p. 180 and table 80. Cell division in the spinal cord after birth has been studied by Hamilton, '01, see table 22 and Allen (12) see table 23.

b) Peripheral. 1) Cerebral nerves. Fortuyn ('14) counted 3000 myelinated fibers in the n. cochlearis of the Norway rat.

Boughton ('06) studied the increase with age (body weight) in the number of myelinated fibers in the oculomotor nerve in the albino rat and measured the areas of the entire fiber and the axis in osmic preparations. The results are given in table 25.

2) Spinal nerves and ganglia. One of the larger spinal ganglia from a cervical nerve root of an Albino weighing 140 grams was fixed in a formalin-acetic sublimate mixture (6, loc.

TABLE 25

Oculo motor nerve

BODY WEIGHT IN GRAMS AND SEX	NUMBER OF FIBERS			AREAS IN μ^2		PERCENTAGE OF AXIS
	Large	Small	Total	Entire fiber	Axis	
11 M........	764		764			
14 M........	880	38	918	13.2	6.6	50
44 M........	885	220	1105			
51 F........	926	227	1153			
80 F........	887	290	1177	41.8	21.2	51
109 F........	888	329	1217			
172 M........	882	465	1347			
192 M........	932	316	1248			
213 M........	925	383	1308			
218 M........	926	471	1397			
278 M........	901	566	1467			
318 M........	930	379	1309			
414 M........	928	408	1336	56.7	27.3	48

cit. p. 3) by Hatai ('01) and cut in paraffin sections 6–7 μ thick.

Selecting cells according to size from large to small the measurements of the cell body and the nucleus were made as in table 26.

TABLE 26

SERIES	NO. OF CELLS	AVERAGE DIAMETERS IN μ	
		Cell body	Nucleus
A....................	10	55 × 46	18 ×15
a....................	10	38 × 25	15 × 14
B....................	5	26 × 23	13 × 12
b....................	5	19 × 17	10 × 10

Further studies on the spinal roots and ganglia were made by Hatai ('02) and ('03 b).

From a series of male Albinos the spinal ganglia with accompanying dorsal root nerves were fixed in one per cent osmic acid and cut in paraffin. The measurements on this material Hatai ('02) are given in table 27. Incorporated in the same table

are the enumerations for the myelinated fibers in the ventral roots (Hatai, '03 b).

It was found that the number of myelinated fibers in the ventral roots diminishes from sections near the spinal cord to those near the spinal ganglion. The amount of the diminution decreases with the age (body weight) of the rat. The increase in the number of cells in the spinal ganglia from the small to the large rats is certainly due in part to the fact that in the small animals some of the smallest ganglion cells escape enumeration.

The increase in the number of myelinated fibers in the spinal roots with advancing age is due mainly to progressive myelination. Both roots at maturity still contain functional fibers without myelin sheaths (Ranson, '06).

TABLE 27

Number of ganglion cells and number and size of myelinated root fibers in spinal nerves from three levels of the spinal cord at five ages (body weights)
Results from Tables II, VI and VIII combined. Hatai ('02)
Also data on ventral root fibers from Hatai ('03 b)

	BODY WEIGHT IN GMS.	TOTAL OF MYELINATED VENTRAL ROOT FIBERS	TOTAL OF GANGLION CELLS	TOTAL OF MYELINATED DORSAL ROOT FIBERS	TOTAL COMPOSED OF MATURE FIBERS	IMMATURE FIBERS	MEAN DIAMETER IN μ OF 20 *largest* DORSAL ROOT FIBERS ENTIRE
VI Cervical	10.3	558	10996	1998	1043	955	7.5
	24.5	1007	9793	2569	2263	306	11.6
	68.5	1302	11772	3683	3569	114	13.3
	167.0	1474	12200	4227	4173	54	13.9
	264.3	1522		4028			
IV Thoracic	10.3	286	7142	607	283	424	4.8
	24.5	434	7068	683	497	366	7.1
	68.5	561	7611	1420	1259	161	8.9
	167.0	613	7406	1522	1460	82	11.6
	264.3	772		1650			
II Lumbar	10.3	333	8315	723	303	420	5.1
	24.5	698	8200	911	678	233	8.0
	68.5	704	9514	1317	1181	136	11.3
	167.0	1028	9442	1644	1565	79	12.0
	264.3	965		2102			

For the numerical relations of cells and fibers in the second cervical nerve data have been furnished by Ranson ('06).

TABLE 28

Second cervical nerve

Observations on normal male rats (Albinos.) Osmic acid fixation—paraffin sections

AGE IN DAYS	BODY WEIGHT	CELLS IN GANGLION	NUMBER OF MYELINATED FIBERS	
			Dorsal root	Ventral root
72.............	110	7721	2472	689
72.............	110	8116	2394	660
72.............	110		1959	590
72.............	110		2217	591
72.............	155	9343		
	161		2090	672
240 (left side)...	188	8624	2689	703
240 (right side).	188		2891	773
	302		2386	646

When the number of myelinated fibers in the two rami on the distal side of the II cervical spinal ganglion is compared with the total number found in the two roots—a distal excess in the number of fibers is found. This is shown in table 29. The distal excess appears to be due to branching of the fibers in their course, Ranson ('06).

TABLE 29

BODY WEIGHT GMS.	IN ROOTS			DISTAL EXCESS		IN RAMI		
	Ventral	Dorsal	Sum	Absolute	Percentage	Sum	Ventral Ramus	Dorsal Ramus
161.......	672	2090	2762	276	10	3098	708	2390
302.......	646	2386	3032	257	8	3289	887	2402

Enumerations of the myelinated fibers in the ventral roots of the II spinal nerve of the Albino have been made by Dunn ('12). Each record is the mean of two enumerations of rats of like age. Areas in μ^2 of the entire fiber and of the axis—together with the percentage value of the axis. Each entry is based on the mean of the 20 largest fibers. In this series there is a change

in the relative area of the axis with age, as well as a decrease in the total areas in the oldest group.

TABLE 30

Giving for Albinos of different ages the numbers of myelinated fibers in the ventral root of the second cervical nerve and the areas of the fibers. Dunn ('12)

AGE, NUMBER, SEX	WEIGHT	NUMBER FIBERS	AVERAGE AREA TEN LARGEST FIBERS	AVERAGE AREA OF AXES IN μ^2	PERCENTAGE OF AXIS
	grams				
7 days					
Two females....	8.59	368	17.2	10.6	61.6
Two males.....	9.33	366	22.3	13.9	62.3
14 days					
Two females ...	20.92	542	38.5	18.1	47.0
Two males.....	21.33	565	32.9	15.2	46.2
36 days					
Two females ...	42.24	653	78.2	31.2	40.0
Two males.....	41.93	613	80.6	31.7	39.3
75 days					
Two females....	136.70	560	115.4	49.6	43.0
Two males.....	169.55	668	116.9	52.8	45.1
132 days					
Two females ...	164.26	683	136.0	59.3	43.6
Two males.....	267.00	625	141.0	63.2	44.8
180 days					
Two females....	212.50	518	168.8	75.9	44.9
Two males.....	264.80	609	201.3	98.2	48.7
270 days					
Two females....	176.91	776	261.0	133.4	51.3
Two males.....	340.05	617	216.8	107.1	49.4
640 days					
Three males....	334.47	864	170.7	78.2	45.8

From a study of the diameters of the cell bodies and their nuclei in the second cervical spinal ganglion of the adult Albino, values which apply to the mean of the entire cell 'population' of this ganglion have been obtained (Hatai, '07 b). The ganglion examined was from a mature male weighing 194 grams. The

ganglion was fixed in osmic acid and imbedded in paraffin. The mean values are as follows:

TABLE 31

	MEAN DIAMETER	STANDARD DEVIATION	COEFFICIENT OF VARIATION
	μ		
Cell body	28.6	14.9	18.4
Nucleus	13.1	1.8	13.7

On the basis of these observations, formula (12) was devised for computing the diameter of the nucleus from the diameter of the cell body.

For comparison with the data in table 31 see data in table 26 obtained by a different method of fixation.

The number of myelinated fibers in the peroneal nerve of the normal Albino is given from Greenman's observations ('13) in table 32. Ages not known.

TABLE 32

LEVEL OF SECTION COUNTED	BODY WEIGHT 104 F. RIGHT NERVE	BODY WEIGHT 117 F. RIGHT NERVE	BODY WEIGHT 182 M. LEFT NERVE	AVERAGES
1. Proximal	2240	2430	2192	2288
Distance from 1 to 2 in mm.	3.0	4.7	3.1	
2. Middle	2118	2292	2418	2276
Distance from 2 to 3 in mm.	4.5	2.3	3.3	
3. Distal	2392	2213	2364	2323
Averages	2250	2312	2325	2296

TABLE 33

Normal Albinos: Sectional area of ten largest in μ^2; relation of axis to sheath

	PROXIMAL END			DISTAL END		
Body weight	Entire fiber	Axis	Per cent of axis	Entire fiber	Axis	Per cent of axis
104	109.8	55.6	50.6	85.0	42.3	49.7
117	137.7	75.2	54.6	85.8	42.6	49.6
182	150.3	82.9	55.1	113.0	56.7	50.1
Average 135	132.6	71.2	53.7	94.6	47.2	49.9

Greenman ('13) also found in osmic preparations the sectional areas of the 10 largest myelinated fibers and the areas of their axes. The length of nerve used was 10 mm. The results are given in table 33.

3) Autonomic. In the course of a study intended primarily to determine whether the small myelinated fibers in the spinal accessory could be regarded as representing the fibers of the rami communicantes, Roth ('05) in a series of cervical nerves, counted on one side the number of myelinated fibers 4 μ or less in diameter, and in the corresponding ramus communicans he also counted the myelinated fibers of like size. His findings are given in table 34.

TABLE 34

NERVE	MYELINATED FIBERS LESS THAN 4 μ IN DIAMETER IN VENTRAL ROOT		MYELINATED FIBERS LESS THAN 4 μ IN RAMUS COMMUNICANS
	Rat I	Rat II	
2nd cervical...........	130	168	None
3rd cervical...........	105	126	None
4th cervical...........	380	363	195
5th cervical...........	432	449	220

c) Technical methods. To determine the effects of various fixatives on the brain of the rat, King ('10) carried through a series of weighings of mature rat brains which had been subjected to the action of various fixatives. A summary of the results is given in table 35.

The solution of Ohlmacher ('97), the formula for which is as follows:

Absolute alcohol, 80 parts.
Chloroform, 15 parts.
Glacial acetic acid, 5 parts.
Corrosive sublimate to saturation (about 20 per cent)

was found to give excellent results with the cells of the cerebral cortex.

TABLE 35

Summary of Data Collected (King '10)

RAT NO.	SEX	BODY WEIGHT IN GRAMS	BODY LENGTH IN MM.	NORMAL WEIGHT OF FRESH BRAIN COMPUTED	SOLUTIONS USED FOR FIXATION	NO. HOURS SOLUTIONS ACTED	WEIGHT OF BRAIN IN GRAMS WHEN REMOVED FROM SOLUTION	PER CENT GAIN OR LOSS IN WEIGHT	WEIGHT OF BRAIN IN GRAMS AFTER REMAINING IN 70% ALCOHOL FOR 48 HOURS	PER CENT GAIN OR LOSS IN WEIGHT
1	♂	277	219	1.94	4% Formaldehyde....	48	2.5750	+33	1.5706	−19
2	♂	163	196	1.83	4% Formaldehyde....	48	2.8200	+54	1.6463	−10
3	♀	158	199	1.85	Formol-Müller (cold)	20	2.2437	+21	1.5537	−16
4	♀	129	183	1.78	4% Formaldehyde....	48	2.6778	+50	1.6577	− 7
5	♀	164	188	1.80	Formol-Müller (warm)............	3	2.1880	+22	1.8711	+ 4
6	♂	187	198	1.85	Ohlmacher...........	5	1.6100	−12	1.4471	−22
7	♀	137	184	1.78	Ohlmacher...........	2	1.7389	− 2	1.4099	−21
8	♂	160	190	1.81	Zenker............ / Müller............	6 / 48	1.8716	+ 3	1.6666	− 8
9	♀	170	197	1.84	Dahlgren.......... / Müller............	4 / 48	1.9000	+ 3	1.7273	− 7
10	♂	182	186	1.79	Picro-formol.........	4	1.7881	− 0	1.4663	−18
11	♂	275	228	1.98	Ohlmacher...........	6	1.8267	− 8	1.6248	−18
12	♂	206	207	1.88	Ohlmacher...........	2	1.6924	−10	1.5748	−16
13	♂	228	210	1.90	Ohlmacher...........	4	1.5787	−17	1.4498	−25
14	♂	169	194	1.83	Ohlmacher...........	3	1.5458	−16	1.4633	−20
15	♂	126	157	1.65	Ohlmacher...........	3	1.3978	−16	1.3099	−21
16	♂	158	181	1.77	Ohlmacher...........	3	1.4590	−18	1.4000	−21
17	♂	232	199	1.85	Ohlmacher...........	3	1.6390	−11	1.4875	−20
18	♀	111	154	1.63	Zenker-formol........	$1\frac{1}{2}$	1.6040	− 2	1.3297	−18
19	♀	106	159	1.66	Zenker (modified)....	$1\frac{1}{4}$	1.7451	+ 5	1.3167	−21
20	♂	6		0.30	Ohlmacher...........	1	0.2523	−16	0.2074	−31
21	♀	6		0.29	Ohlmacher...........	2	0.2489	−14	0.2011	−30
22	♂	108	156	1.64	$2\frac{1}{2}$% $K_2Cr_2O_7$.........	48	2.8445	+73	2.1409	+31
23	♂	88	163	1.68	$2\frac{1}{2}$% $K_2Cr_2O_7$.........	48	2.5594	+52	1.7518	+ 4
24	♂	162	187	1.79	Alcohol $K_2Cr_2O_7$.....	48	2.5073	+40	1.8885	+ 6
25	♂	190	207	1.88	Alcohol $K_2Cr_2O_7$.....	48	2.8169	+50	2.1797	+16
26	♂	174	184	1.78	Weak alcohol........	27	1.7753	−00	1.6201	− 9
27	♂	168	191	1.81	Alcohol-formol.......	24	1.6392	−10	1.5147	−16
28	♂	221	198	1.85	95% Alcohol.........	24	1.4418	−22	1.4611	−21
29	♂	151	184	1.78	Sublimate-acetic.....	$1\frac{1}{2}$	1.8604	+ 5	1.4484	−19
30	♂	213	202	1.86	Carnoy's fluid........	3	1.8192	+ 2	1.4077	−24
31	♂	181	194	1.82	Carnoy's fluid........	4	1.7575	− 3	1.3042	−23
32	♀	141	178	1.75	Graf (5% formalin)	$2\frac{1}{2}$	2.1520	+23	1.7421	−00
33	♂	165	191	1.81	Graf (10% formalin)	$1\frac{1}{2}$	1.9283	+ 7	1.5994	−12
34	♀	149	184	1.77	Carnoy's fluid........	19	1.7416	− 2	1.3110	−28

TABLE 35—Concluded.

RAT NO.	SEX	BODY WEIGHT IN GRAMS	BODY LENGTH IN MM.	NORMAL WEIGHT OF FRESH BRAIN COMPUTED	SOLUTIONS USED FOR FIXATION	NO. HOURS SOLUTIONS ACTED	WEIGHT OF BRAIN IN GRAMS WHEN REMOVED FROM SOLUTION	PER CENT GAIN OR LOSS IN WEIGHT	WEIGHT OF BRAIN IN GRAMS AFTER REMAINING IN 70% ALCOHOL FOR 48 HOURS	PER CENT GAIN OR LOSS IN WEIGHT
35	♀	167	189	1.80	Lang's fluid..........	20	2.0670	+15	1.6794	− 7
36	♂	208	203	1.86	Lang's fluid..........	4	2.0429	+10	1.7970	− 3
37	♀	173	194	1.82	Marina's fluid........	72	1.2219	−33	1.2913	−29
38	♂	197	201	1.86	Marina's fluid........	96	1.2146	−35	1.2546	−33
39	♂	259	214	1.92	Cor. sublimate.......	4	2.0760	+ 8	1.4695	−23
40	♂	177	195	1.83	Cor. sublimate.......	20	2.0229	+11	1.4087	−23
41	♂	265	216	1.92	Sublimate-formol.....	4	2.3315	+21	1.6565	−14
42	♂	213	203	1.86	NaCl + sublimate....	4	1.9927	+ 7	1.3947	−25
43	♀	213	204	1.86	Tellyesniczky........	48	1.9643	+ 6	1.6372	−12
44	♀	137	177	1.74	Tellyesniczky........	24	1.7981	+ 3	1.4906	−14
45	♂	196	200	1.85	NaCl + sublimate....	20	2.1549	+16	1.5074	−19
46	♀	135	179	1.75	Sublimate-formol....	20	2.0512	+17	1.3687	−22
47	♂	141	179	1.75	Cox (osmic)..........	48	1.9917	+ 2	1.5483	−12
48	♂	150	182	1.76	Cox (osmic)..........	72	2.1555	+22	1.8365	+ 4
49	♂	171	192	1.81	Cox (formol-acetic)..	48	1.7687	− 2	1.5003	−17
50	♂	137	178	1.75	Cox (formol-acetic)..	72	1.8944	+ 8	1.5221	−13

In a later study King ('13 a) followed in some detail the effects of formaldehyde on the brain of the Albino. The conclusions reached were as follows:

1. A 4 per cent solution of formaldehyde causes a pronounced swelling in the brains of rats of all ages.

2. A solution of formaldehyde undergoes some chemical change on standing, since a solution five months old causes less swelling in the brain of the rat than does a freshly made solution.

3. A 4 per cent solution of formaldehyde neutralized with $NaCO_3$ produces a much greater amount of swelling in the brain of the rat than does a solution that has a faintly acid reaction.

4. A strong neutralized solution of formaldehyde causes a greater percentage weight increase in the rat's brain than does a weak neutralized solution. A reverse result is obtained when the solutions are not neutralized.

5. If rats' brains are subjected to the action of a solution of formaldehyde that is kept at a constant temperature of 36°C., they undergo a greater amount of swelling than is produced when the solution is kept at a temperature of 8 to 11°C. The maximum weight increase in the brains is reached by the end of the first day in the former case, and not until the third day in the latter case.

6. When the conditions under which the solution acts are uniform, the maximum weight increase in rats' brains subjected to the action of a 4 per cent solution of formaldehyde is attained in all cases by the third day, and there is then a gradual decrease in weight. Brains of very young animals tend to reach the maximum earlier than do those of older animals.

7. The percentage weight increase in rats' brains as the result of the action of a 4 per cent formaldehyde solution tends to be greater in the brains of young animals than in those of adults.

8. In animals of the same age the larger brain does not show a greater percentage weight increase after treatment with a solution of formaldehyde than does the smaller one.

9. A 4 per cent solution of formaldehyde extracts solids from the brains of rats of all ages. This is shown by the fact that the percentage of solids in brains that have been subjected to the action of such a solution is always less than that found in the fresh brains of animals of the same age. Brains of very young rats lose much more of their solids than do brains of older animals.

10. Brains of animals infected with pneumonia show a slightly greater percentage weight increase when treated with a 4 per cent solution of formaldehyde than do the brains of healthy animals.

11. Even under the most favorable conditions an aqueous solution of formaldehyde is not a satisfactory fixative for the cell structures in brain tissues, as it causes a pronounced distention of the nuclei and gives a poor preservation of the nuclear contents.

The more important data are given in tables 36, 37, 38, 39, 40.

TABLE 36

Percentage weight increase in rats' brains, each kept for ten weeks on 40 cc. of a neutralized solution of 4 per cent formaldehyde made five months before the experiments began (averages for three brains at each age)

TIME SOLUTION ACTED	AGE OF RATS							
	New-born	10 days	20 days	40 days	50 days	70 days	100 days	200 days
1 day	29.7[1]	28.8	25.0	25.2	26.9[1]	24.5	28.3[1]	15.3
3 days	28.0	35.0[1]	28.3[1]	26.3[1]	26.8	27.3[1]	26.8	21.0[1]
7 days	27.3	33.0	27.3	25.0	25.1	25.1	25.7	18.6
2 weeks	23.9	31.9	27.3	24.5	25.1	25.3	26.3	18.9
3 weeks	23.4	31.4	28.3	24.9	25.5	24.4	25.3	19.3
4 weeks	22.5	30.5	26.7	24.5	24.8	25.6	26.2	19.4
10 weeks	17.6	27.9	26.9	24.7	25.2	25.6	25.0	19.2
Average percentage gain	24.6	31.2	27.1	25.0	25.6	25.4	26.2	18.8

[1] Maximum weight increase.

TABLE 37

Percentage weight increase in rats' brains, each kept for ten weeks in 40 cc. of a neutralized solution of 4 per cent formaldehyde made at the time the experiments began (averages for three brains at each age)

TIME SOLUTION ACTED	AGE OF RATS							
	New-born	10 days	20 days	40 days	50 days	70 days	100 days	200 days
1 day	44.4[1]	58.2	39.5	37.9[1]	39.3[1]	34.4	45.6[1]	32.4
3 days	42.0	64.6[1]	41.5[1]	37.6	38.5	38.6[1]	43.1	34.7[1]
7 days	41.5	62.1	40.1	36.4	35.6	34.1	41.1	30.9
2 weeks	38.0	62.9	39.7	35.9	36.1	34.9	41.0	30.8
3 weeks	37.7	63.4	40.0	35.7	36.9	34.3	40.4	31.2
4 weeks	36.1	62.8	39.9	35.5	35.4	35.7	40.5	31.6
10 weeks	33.9	61.4	39.4	35.5	36.1	35.5	37.7	31.8
Average percentage gain	39.1	62.2	40.0	36.4	36.7	35.4	41.3	31.9

[1] Maximum weight increase.

TABLE 38

Percentage weight increase in rats' brains, each kept for four weeks in 40 cc. of a neutralized solution of 4 per cent formaldehyde made fresh for each lot of animals killed (averages for two brains at each age)

TIME SOLUTION ACTED	AGE OF RATS							
	New-born	10 days	20 days	40 days	50 days	70 days	100 days	200 days
1 day	60.4	54.7	45.8	47.6[1]	50.4[1]	44.9	44.2[1]	36.1
3 days	65.8[1]	58.5[1]	52.9[1]	47.4	47.7	48.8[1]	42.7	40.1[1]
7 days	65.4	58.5	48.3	45.6	45.1	44.2	38.3	36.2
2 weeks	65.1	58.4	48.9	45.3	44.8	43.2	38.6	33.0
3 weeks	64.8	58.2	48.9	44.7	45.2	43.9	38.8	34.7
4 weeks	61.7	57.8	50.4	45.1	45.4	44.9	39.3	34.9
Average percentage gain	63.4	57.7	49.2	35.9	46.4	44.8	40.3	35.8

[1] Maximum weight increase.

TABLE 39

Percentage weight increase in rats' brains, each kept for four weeks in 40 cc. of non-neutralized solution of 4 per cent formaldehyde made fresh for each lot of animals killed (averages for two brains at each age)

TIME SOLUTION ACTED	AGE OF RATS							
	New-born	10 days	20 days	40 days	50 days	70 days	100 days	200 days
1 day	34.5[1]	37.3	36.7	39.7[1]	44.2[1]	39.5	41.1[1]	32.2
3 days	18.6	45.1[1]	45.4[1]	39.1	42.8	42.3[1]	39.4	35.4[1]
7 days	9.9	37.8	38.2	35.6	38.1	34.3	33.8	30.2
2 weeks	3.5	30.4	34.6	31.5	32.6	31.5	29.0	26.7
3 weeks	0.4	25.9	30.7	28.3	30.6	29.5	27.4	24.5
4 weeks	−1.5	23.5	27.9	26.6	27.8	27.3	24.3	24.5
Average percentage gain	13.1	33.3	35.6	33.5	36.0	34.1	32.5	28.9

[1] Maximum weight increase.

TABLE 40

The percentage of solids in brains of rats of various ages kept from four to eighteen weeks in solutions of 4 per cent formaldehyde (computations made from original brain weights)

EXPERIMENTS	AGE OF RATS							
	New-born	10 days	20 days	40 days	50 days	70 days	100 days	200 days
Brains kept 18 wks. in neutralized stock solutions	8.1	10.3	14.7	18.4	19.4	19.5		20.9
Brains kept 10 wks. in sol. 5 mos. old	8.1	10.1	16.5	19.4	19.4	20.5	19.7	20.5
Brains kept 10 wks. in freshly made sol.	7.8	10.3	16.0	19.2	19.5	20.1	20.1	21.6
Brains kept 4 wks. in 40 cc. neutral sol.	8.2	10.1	16.4	19.3	19.6	19.6	20.9	21.8
Brains kept 4 wks. in 40 cc. acid sol.	9.6	10.9	16.7	19.3	19.1	20.7	20.1	21.1
Brains kept 4 wks. in 20 cc. neutral sol.	9.2	9.8	16.2	19.7	20.5	19.9	20.2	21.5
Brains kept 4 wks. in 20 cc. acid sol.	10.5	10.9	16.3	19.0	20.0	20.1	20.8	21.6
Brains kept 4 wks. in neutral sol. at temp. 26°C.	9.7	9.8	15.1	18.7	19.4	19.8	20.1	20.1
Brains kept 4 wks. in neutral sol. at temp. 8 to 11°C.	8.3	10.6	16.3	19.2	19.0	20.1	20.1	21.7
Averages for above series	8.6	10.6	16.3	19.2	19.6	20.1	20.3	21.2
Normal percentage of solids in rats' brains (Donaldson)	12.2	14.6	17.5	19.5	20.9	21.1	21.3	21.6
Percentage loss of solids as result of action of formaldehyde	29.5	29.4	7.4	1.5	6.2	4.7	4.7	1.8

7. *Sense organs.* The cochlea makes $2\frac{1}{4}$ turns (Fortuyn, '14, p. 348).

8. *Integument (see references).*

9. *Gastro-pulmonary systems.* For the weights of the various viscera see tables 68–72.

a) Gastro-intestinal system. The volumes of the liver and pancreas cells—with those of their respective nuclei—have been de-

termined by Morgulis ('11). The organs were fixed in Zenker's solution and imbedded in paraffine and were taken from one normal Albino—110 days old; body length 176 mm.; body weight, 137.7 grams.

TABLE 41

Liver cells

NO. OF MEASUREMENTS OF CELLS	VOLUME IN μ^3 OF		NO. OF MEASUREMENTS OF NUCLEUS	DIAMETERS OF NUCLEUS IN μ
	Entire cell	Nucleus		
100............	5075	247.2	50	7.56 × 8.25
Pancreas cells				
100............	1829	94.3	40	5.48 × 6.00

b) Pulmonary system (see references), also table 70.

10. *Uro-genital system (see references), also table 70.*

11. *Endocrine system (see references), also table 77.*

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6. *Nervous system. a) Central. 1) Brain.* Addison, '11. Allen, '12. Bechterew, 1890. Bradley, '03. Cajal, 1897, 1909–1911. Donaldson, '08, '09, '10, '11, '11 a, '11 b. Donaldson and Hatai, '11, '11 a. Fortuyn, '14. Gentes, '03. Goldstein, '04. Haller, '10. Hamilton, '01. Hatai, '03, '09, '09 a. King, J. L., '10. King, H. D., '11. Lapicque, '07. Lewis, 1881. Meek, '07. Reichardt, '06 Retzius, 1894. Watson, '03. Wagner, 1841. *2) Spinal cord.* Allen, '12. Bardeleben, 1899. Hatai, '02 b. Lenhossek, 1889. Pontier and Gérard, 1900. Ranson, '13, '14 a. Retzius, 1893. Robinson, 1892 a. Spitzka, 1886. Sterzi, '04. Stieda, 1869. Van der Vloet, '06. *b) Peripheral. 1, 2) Cerebrospinal.* Beck, 1896. Benedicenti, 1892. Berkley, 1893, 1895. Bischoff, 1832. Boughton, '06. Cabibbe, '04. Cannieu, '94. Donaldson, 1900, '05. Dunn, '12. Fortuyn, '14. Greenman, '13. Hamilton, '01. Hatai, '01, '01 a, '02, '02 a, '03, '03 b, '03 c, '03 d, '04, '07 b. Krause, 1870. Ploschko, 1897. Ramström, '05. Ranson, '06. Stirling, 1883. *3) Autonomic.* Apolant, 1896. Asp, 1873. Barteneff, 1891. Cajal, 1893. Carpenter and Conel, '14. Fusari and Panasci, 1891. Fusari, 1894. Korolkow, 1892. Martinotti, 1889. Roth, '05. *c) Technical methods.* Cajal, 1889, '03. King, '10, '13 a. Ohlmacher, 1897. Turner, '04.

7. *Sense organs.* Asai, '08. Bulle, 1887. Ebner, 1873. Fortuyn, '14. Gmelin, 1892. Hönigschmied, 1873. Koganei, 1885. Lauber, '01. Lovén, 1868, Mayer, 1843. Münch, 1896. Schäfer, 1900 a. Stahr, '03. Tello, '06. Tuckerman, 1892. Wyss, 1870.

8. *Integument.* Calef, 1900. Durham, '04. Peters, 1890. Romer, 1896.

9. *Gastro-pulmonary systems. a) Gastro-intestinal.* Asher, '08. Asher and Erdely, '03. Asp, 1873. Brümmer, 1876. Bujard, '05, '09. Custor, 1873. Cuvier, 1805. Demjanenko, '09. Edelmann, 1889. Ellenberger and Guenther, '08. Falcone, 1898. Frenkel, 1892. Garnier, 1897. Gillette, 1872. Heuser, '14. Home, 1807. Hoyer, 1890. Klein, 1871. Kupffer, 1876. Langley, 1882. Loewenthal, 1894, 1894 a, 1900, '08. Mayer, 1894. Mazzarelli, 1890. Morgulis, '11. Mouret, 1895. Müller, 1830. Nicolas, 1890. Podwisotzky, 1878. Podwyssotzki, 1882. Ranvier, 1883, 1884, 1885, 1886, 1886 a. Rapp, 1839. Retzius, 1841. Rubeli, 1890. Salter, 1859. Saviotti, 1869. Schmidt, 1863. Schwalbe, 1872. Severin, 1885. Toepfer and Fleischmann, 1891. Watney, 1874. Zillinberg-Paul, '09. Zumstein, 1891. *b) Pulmonary system.* Arnstein, 1877. Frankenhaeuser, 1879. Fuchs-Wolfring, 1898. Gegenbaur, 1892. Guieysse, 1898. Hansemann, 1895. Klein, 1875. Linser, 1900. Livini, 1896. Miller, 1893. Schulze, 1871. Zumstein, 1890.

10. *Urogenital system.* Beiling, '06. Belloy, 1899. Disselhorst, 1897, 1897 a, '04. Fischel, '14. Harz, 1883. Leydig, 1850. Lowenthal, 1897. Mueller, '02. Oudemans, 1892. Rauther, '03. Regaud, 1900, 1900 a, 1900 b, 1900 c, '01, 01 a, '01 b, '01 c, '01 d, '02, '02 a, '03. Stutzmann, 1898. Watson and Campbell, '06.

11. *Endocrine system* (see also Endocrine system under Physiology). Dostoiewsky, 1886, 1886 a. Elliot and Tuckett, '06. Erdheim, '06. Gemelli, '03, '05, '06. '06 a. Hatai, '14, '14 a. Sandri, '08. Stendell, '13. Tilney, '11, '13. Vincent, '10. Watson, C., '07, '09.

CHAPTER 4

PHYSIOLOGY

1. Muscle and nerve. 2. Nervous system. a) Central. b) Peripheral. b[1]) Degeneration. b[2]) Regeneration. 3. Special senses. 4. Blood and lymph. 5. Circulation—blood and lymph. 6. Respiration. 7. Digestion and secretion (exclusive of ductless glands). 8. Nutrition. a) Body temperature. 9. Reproduction. 10. Endocrine system.

The quantitative data for the functions of the normal Albino are rather scanty. Those available are given in their topical order and the references at the end of the chapter are also arranged by topics—as usual.

Tabular records for the very important studies of Osborne and Mendel on the modifications of body growth by the use of various proteins are reluctantly omitted because of the general plan of presenting in these pages data for the normal rat only.

8. *Nutrition.* A study of the nitrogen excretion has been made by Hatai ('05). Chicago Colony, ration: Uneeda biscuit and water.

From observations on 89 male rats at different ages and weights the following results were obtained:

1. The total amount of urine increases with the weight up to 120 grams, then decreases very decidedly. From 180 grams it again increases up to 220 grams, beyond which weight it remains rather constant. A diminution of urine in animals between 120 and 180 grams, or approximately 70–125 days old, seems to be a normal phenomenon rather than mere statistical variation. Whether or not this is a phenomenon of adolescence needs further investigation. It must be noted, however, that puberty in the rat begins at about seventy days after birth. The smaller animals excrete a relatively greater quantity of urine than the larger animals.
2. The total amount of nitrogen is quite independent of the amount of urine, and increases constantly and continuously throughout life. The smaller rats, however, excrete a relatively greater quantity than the larger animals.
3. The percentage value of urinary nitrogen is 91 per cent of the total in the case of smaller animals, and 89 per cent in the case of the larger.

TABLE 42

Showing the amount of urine, feces, and nitrogen during three days. Male rats alone were used

BODY WEIGHT	NO. OF ANIMALS	URINE	FECES	NITROGEN IN URINE	NITROGEN IN FECES	TOTAL NITROGEN
gm.		*cc.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*
		5.75	327	52	4	56
38	8	6.25	217	45	4	49
		5.00	105	42	1	43
Average		5.7	216	46	3	50
		12.62	347	85	11	96
53	7	9.52	0	65	0	65
		9.17	57	54	3	57
Average		10.4	135	68	5	73
		16.69	395	93	13	106
70	8	10.87	205	103	7	110
		10.41	68	92	3	95
Average		12.8	223	96	8	104
		15.9	438	97	22	119
85	5	12.4	219	102	4	106
		9.5	330	83	13	96
Average		12.6	329	94	13	107
		15.50	556	137	20	157
99	6	10.83	38	124	3	127
		8.98	199	100	5	105
Average		11.8	264	120	9	130
		15.41	374	122	10	132
106	6	17.67	294	119	5	124
		17.33	248	110	18	128
Average		16.8	305	117	11	128
		22.3	776	143	26	169
116	5	14.5	138	135	8	143
		18.0	39	123	0	123
Average		18.3	318	134	11	145
		18.25	906	120	26	146
127	4	13.00	346	115	17	132
		18.75	127	129	6	135
Average		16.7	460	121	16	138
		17.58	359	153	15	168
144	5	16.25	360	166	10	176
		15.00	49	113	1	114
Average		16.3	256	144	9	153
		13.90	425	126	14	140
156	5	13.90	638	151	16	167
		15.75	445	169	17	186
Average		14.5	503	149	16	165

BODY WEIGHT	NO. OF ANIMALS	URINE	FECES	NITROGEN IN URINE	NITROGEN IN FECES	TOTAL NITROGEN
gm.		*cc.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*
		16.13	748	162	32	194
162	4	11.50	208	140	11	151
		12.00	227	141	16	157
Average		13.2	394	148	20	168
		12.13	379	187	17	204
178	4	12.00	482	154	21	175
		13.38	374	162	15	177
Average		12.5	412	168	18	185
		16.00	177	194	9	203
191	3	17.30	163	185	9	194
		11.30	348	164	17	181
Average		14.9	229	181	12	193
		19.30	776	158	29	187
207	4	10.80	516	182	24	206
		19.00	195	181	7	188
Average		16.4	496	174	20	194
		24.00	809	217	42	259
220	2	20.00	235	181	8	189
		19.00	382	148	29	177
Average		21.00	475	182	26	208
		18.80	794	207	30	237
239	4	17.80	502	175	15	190
		18.00	404	178	16	194
Average		18.2	566	187	20	207
		20.38	333	204	21	225
266	4	24.00	896	225	32	257
		22.00	690	259	28	287
Average		22.1	639	229	27	256
		20.25	956	246	37	283
298	5	18.00	638	272	26	298
		17.35	598	262	24	286
Average		18.5	731	260	29	289
		16.88	1424	261	25	286
333	3	26.50	475	280	20	300
		19.50	857	297	37	334
Average		20.9	919	279	27	306
		13.00	877	250	45	295
370	3	12.80	817	289	32	321
		19.30	217	291	9	299
Average		15.00	637	277	29	306

4. The total amount of nitrogen eliminated by the rat during twenty-four hours at different weights may be determined with a high degree of accuracy by the formula (33).

The normal protein metabolism of the rat has been studied by Folin and Morris ('13). They find a distribution of nitrogen in the urine as shown in tables 43, 44.

TABLE 43

Female rat weighing 290 grams. Average of 5 days

	MGM.	PER CENT
Total N	173.50	100.00
Urea N	143.20	77.30
Ammonia N	9.10	5.20
Uric Acid N	0.69	0.40
Creatinine N	4.50	2.65
Creatinine + Creatine N	4.70	2.71

TABLE 44

Male rat weighing 197 grams. Average of 6 days

	MGM.	PER CENT
Total N	126.00	100.00
Urea N	105.90	84.00
Ammonia N	6.70	5.30
Uric Acid N	0.52	0.41
Creatinine N	2.90	2.30
Creatinine + Creatine N	3.00	2.38

"It will be seen from examination of the average results that the percentage composition of rat urine differs but little from that of human urine."

a) *Body temperature.* Using the mercurial thermometer in the rectum, Pembrey ('95) reports a body temperature of 37.5°C. in adult Albinos. Macleod ('07) by the same method finds a range of 37.5–38.5°C. with a mean of 37.9°C.; Congdon ('12) also by the same method a temperature of 37.9°C. in the young; in the adult, when reared at 16°C., a temperature of 36.2°C. and when reared at 33°C., of 37.2°C. Graham and Hutchison

('14) using the thermoelectric method of Philips and Demuth—obtained the following:

TABLE 45

EXTERNAL TEMPERATURE	BODY TEMPERATURE (C.) High	BODY TEMPERATURE (C.) Low
5 C. Series (a)	36.1	21.1
Series (b)	34.9	19.0
21 C.	38.7	32.4
37 C.	41.8	32.9

PHYSIOLOGY: REFERENCES

1. *Muscle and nerve.* Boinet, 1895. Engelmann, 1877. Lee, '10. Mellanby, '08.

2. *Nervous system. a) Central.* Ferrier, 1886. Hatai, '03 a, '04 a, '07 a, '08, '15 a. Mills, 1897. Schäfer, 1900. Watson, '05. *b) Peripheral. b[1]) Degeneration. b[2]) Regeneration.* Greenman, '13. Ranson, '03, '04, '06, '14. Tournade, '13.

3. *Special Senses.* Bogardus and Henke, '11. Hunter, '14. Vincent, '12, '13, '15, '15 a, '15 b.

4. *Blood and Lymph.* Erdély, '05. Robertson, 12. Rywosch, '07. Trommsdorf, '09.

5. *Circulation.* Rattone and Mondino, 1888, 1888 a, 1889, 1889 a.

6. *Respiration.* Bert, 1878. Boycott and Damant, '08 a. Boycott and Damant and Haldane, '08. Pembrey, 1895. Pembrey and Spriggs, '04.

7. *Digestion and Secretion (exclusive of the ductless glands).* Ackroyd, '14, '15. Astaschewsky, 1877. Basch, 1870. Basler, '09. Bohlen, 1894. Drasch, 1886. Eimer, 1869. Ellenberger, '06. Elliott and Barclay-Smith '04. Gruetzner, 1875, 1878, 1894, 1898, '05. Hohmeier, '01. Jolyet and Chaker, 1875. Langley and Sewall, 1879. Langley, 1879. Matthes and Marquardsen, 1898. Paneth, 1888, 1888 a. Ranvier, 1887, 1888, 1894. Schiff, 1859. Zawarykin, 1883.

8. *Nutrition and body temperature.* Aldrich, '12. Aron, '12, '13. Brüning, '14, '14 a. Chidester, '12. Congdon, '12. Cook, '13. Czermak, 1895. Falta and Noeggerath, '05. Folin and Morris, '13. Forbes and Keith, '14. Frank and Schittenhelm, '12. Gevaerts, '01. Graham and Hutchison, '14. Greggersen, '11. Gudernatsch, '15. Hart and McCollum, '13. Hatai, '05. Hewer, '14. Heymann, '04. Hill, '13. Hill and Macleod, '03. Hopkins, '12. Hopkins and Neville, '12. Hunt, '10. Hunter, Givens and Guion, '14. Jackson, '15 b. Jacob. '06. Knapp, '08. Kreidl and Neumann, '08. Lane-Claypon, '09. Langlois and Loir, '02. McCollum, '09. McCollum and Davis, '13, '13 a, '14. Macleod, '07. Mendel, '13. Morgulis, '11. Osborne, '13. Osborne and Mendel, '11, '11 a, '11 b, '12, '12 a, '12 b, '12 c, '12 d, '12 e, '12 f, '12 g, '13, '13 a, '13 b '14, '14 a, '14 b, '14 c, '14 d, '14 e, '15. Paul, '06. Pembrey. 1895. Pitts, 1898. Poljakoff, 1888. Rohdé and Jones, '09. Watson, B. P., '07. Watson, C., '06,

'06 a, '06 b. '07 a, '07 b, '07 c, '07 d, '10 '12. Watson and Lyon, '06. Watson and Gibbs, '06.

9. *Reproduction.* Carmichael and Marshall, '07. Cuénot, 1899. Fischel, '14. Hewer, '14. Marshall and Jolly, '07, '08. Regaud, 1900 d, 1900 e, 1900 f. Steinach, '10, '11, '12, '13.

10. *Endocrine System.* Barnabo, '13. Biedl, '13. Boinet, 1895, 1895 a. Brown-Sequard, 1856. Cristiani, 1893, 1893 a, 1893 b, 1895, 1900. Cristiani and Cristiani, '02, '02 a, '02 b, '02 c, '02 d. Erdheim, '06 a, '07, '11, '11 a, '11 b. Gemelli, '06. Goetsch and Cushing, '13. Goldmann, '09, '12. Harley, 1857, 1858, 1858 a, 1858 b. Hohlbaum, '12. Hunt and Seidell '09. Iselin, '08. Leischner, '07. Leischner and Köhler, '11. Leopold and Reuss, '08. Olds, '10. Poll, 1898, 1899. Schäfer, '08. Schiff, 1884, 1884 a. Steinach, 1894. Strehl and Weiss, '01. Toyofuku, '11. Vincent, 1897, 1897 a. '12. Vincent and Jolly, '05, '06. Watson, C., '14. Wiesel, 1899, 1899 a.

CHAPTER 5

GROWTH IN TOTAL BODY WEIGHT ACCORDING TO AGE

1. Introduction. 2. Growth before birth. 3. Growth between birth and maturity. 4. Modifications of growth in total body weight. 5. Weight-length ratios.

1. *Introduction.* Under the general caption of growth several series of data are grouped in this chapter and in the four chapters which follow it. The chapter heads explain the several groupings and show that some data are presented according to age and other data according to some bodily measurement.

The reasons for this procedure will be evident in each instance. The effort has been made to gather as much of the data as possible under the caption of growth as this seemed the best way to make the records available for reference.

The following tables present the size, weight and composition of the albino rat and some of its parts, under conditions which may be considered normal.

As regards absolute measurements, it must be borne in mind that the Albino is very responsive to external conditions as represented by food, housing, temperature, exercise, and incidental disturbances, especially light and noises.

No two colonies today are kept under more than approximately similar conditions and it follows that the average size of the animals from different colonies varies. The conditions just noted also appear to influence the relative weights of some of the viscera. For these reasons, each set of determinations will be accompanied by a statement, as complete as possible, concerning the special conditions surrounding the animals on which the observations were made.

2. *Growth before birth.* For the data on growth during the first few days of fetal life, see Chapter 3, Embryology, early stages, pp. 31–33 Huber ('15 a) and other references there given.

At about the 13th day after insemination the fetus is large enough to be directly weighed and from this date to birth the growth has been followed.

In a series of 38 females, each of which had already born one litter, Stotsenburg (MS '15) has observed exactly the time of

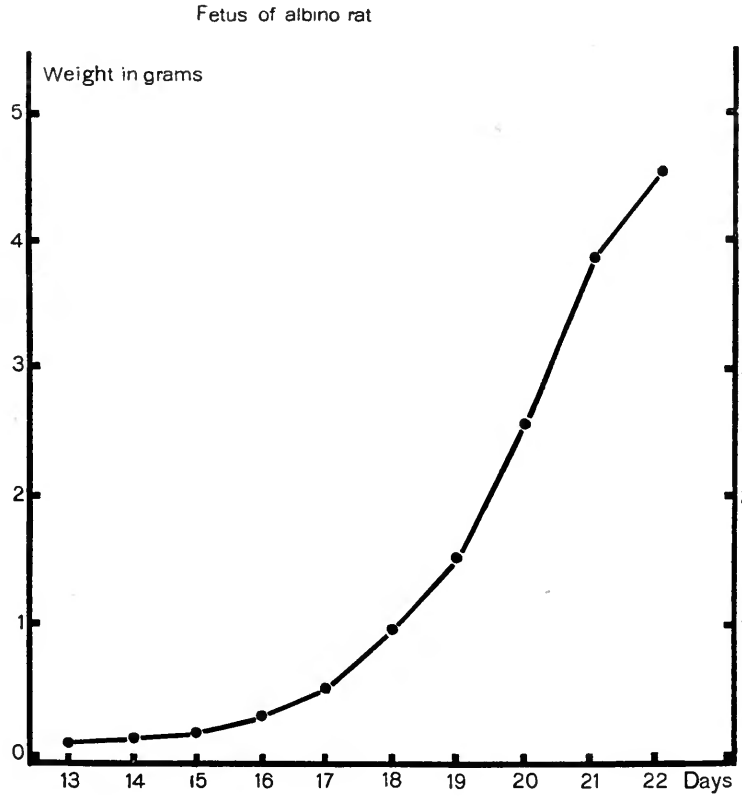

Chart 1 shows the course of fetal growth from the 13th to the 22nd day gestation. Stotsenburg (MS '15). The data are given in table 46.

insemination and then weighed the fetuses at the ages given in table 46. Before weighing the membranes were removed and in some instances the crown-rump length was measured (table 47). The graph representing the growth before birth from the 13th day on is given in chart 1, the interval used for one day being two-fifths of that used for one gram.

3. *Growth between birth and maturity.* The first observations were made at the University of Chicago by Donaldson, Dunn and Watson ('06) on stock rats fed mainly on milk-soaked bread

TABLE 46

Showing the mean weights of the fetuses at ten ages during gestation

AGE IN DAYS	NUMBER OF FETUSES	AVERAGE WEIGHT OF FETUS IN GRAMS	RATE OF INCREASE IN WEIGHT
			per cent
13	34	0.040	
14	44	0.112	179
15	37	0.168	50
16	44	0.310	83
17	21	0.548	77
18	43	1.000	83
19	30	1.580	58
20	25	2.630	65
21	42	3.980	51
22	10	4.630	16

TABLE 47

Giving the crown-rump length of fetus in millimeters. Scrap diet only. The fetuses here measured are part of those used for Table 46

SERIAL NUMBER	AGE IN DAYS	NUMBER IN LITTER	AVERAGE WEIGHT OF FETUS IN GRAMS	AVERAGE CROWN-RUMP LENGTH IN MM.	RANGE OF LENGTH IN MM.
42	14	8	0.093	9.5	9.0–10.0
43	15	12	0.107	9.4	9.0–10.0
37	15	8	0.218	12.1	12.0–12.5
41	16	11	0.322	13.0	12.5–13.0
40	17	7	0.525	16.3	16.0–17.0
36	18	9	0.947	19.1	18.0–21.0
37	19	8	1.490	22.7	20.5–24.0
35	20	10	2.510	27.7	24.0–32.0
34	21	9	4.070	36.7	35.0–39.0
44	22	10	4.630	39.2	36.0–41.0

with corn as a staple. The values before fourteen days of age were obtained from weighing different litters, each litter being weighed only once. The original values at birth and for the first ten days were plainly too high and have been replaced by new

data (Donaldson, MS '14). After the 14th day the weighing of 19 males and 17 females was made at frequent intervals, so long as the animals kept in good condition. Tables 63 and 64 give for males and females respectively not only the mean values but the range, and in the case of the females, after 90 days, the

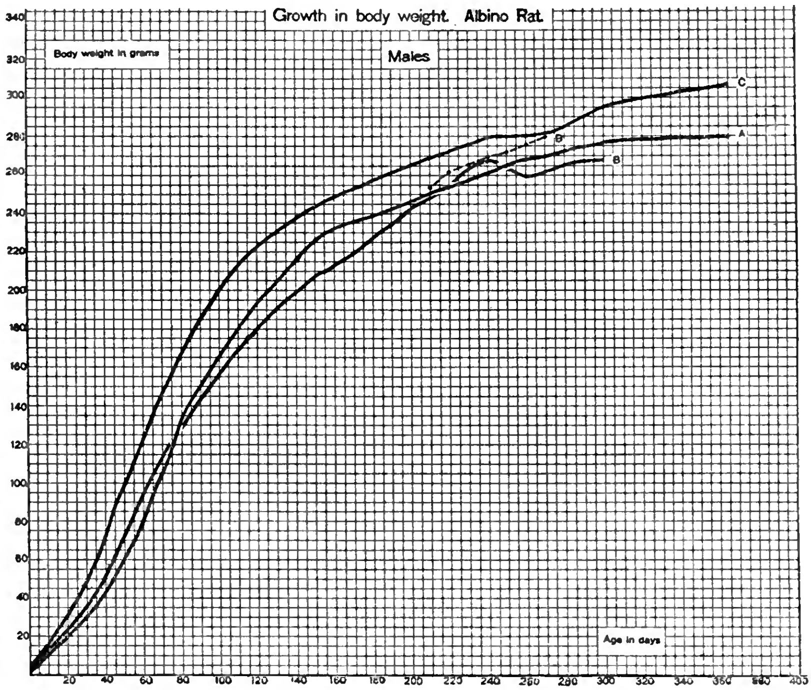

Chart 2 Growth in body weight on age. Male albino rat.
A. Observations of Donaldson, Dunn and Watson ('06). See table 63.
B. Observations of Ferry, '13. See table 65.
B'. Observations of Ferry, '13. See column 2, table 65.
C. Observations of King (MS '15). Data from two series combined. See table 67.

observed values for the unmated animals are accompanied by a second series of values computed for mated rats on the basis of Watson's ('05) observations which show that mated females gain in weight about 0.03 per cent per diem faster than the unmated. These data are used for graph A, chart 2, males, and graph A, chart 3, females.

Using the mean values in table 63 for the males from 10 days of age on, and the corresponding values in table 64 for the females and taking the records for the mated females where given, Hatai has determined the graph for which formulas 34 and 35 give the values for the male, and formulas 36 and 37 the values for the female for this special series. By the use of these formulas the body weights have been computed for each day of age

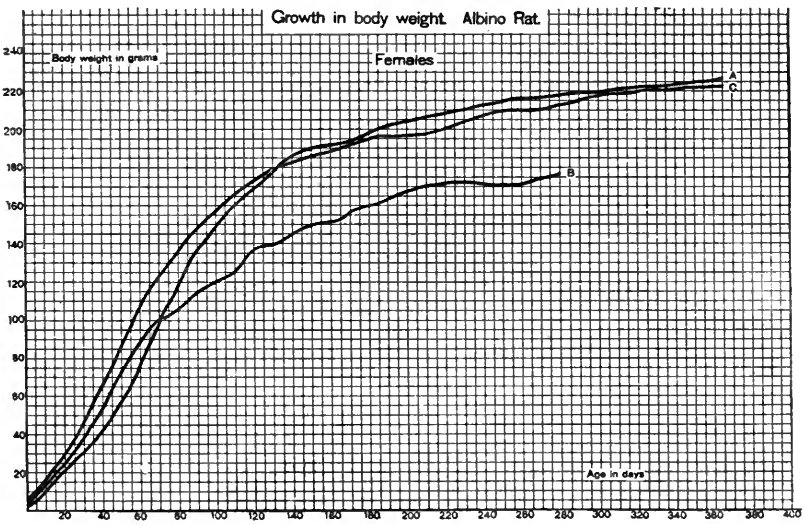

Chart 3 Growth in body weight on age. Female albino rat.
A. Observations of Donaldson, Dunn and Watson ('06). See table 64.
B. Observations of Ferry, '13. See table 65.
C. Observations of King (MS '15). Data from two series combined. See table 67.

from 10–100 days and at intervals of five days from 100–365 days (see table 62).

The values given for the first ten days of age in table 62 have been obtained from a revised series of direct observations Donaldson (MS '14).

The weight at birth as here given, is for rats that have suckled.

A second series of data for body weight on age have been gathered by Miss Ferry.

Using the rats from the colony maintained for the experiments of Osborne and Mendel at the Connecticut Agricultural Station in New Haven, Ferry ('13) has recorded the growth with age from the 10th to the 280th day of life.

The diet of the rats consisted of Austin's dog-biscuit, and sunflower seeds with fresh vegetables (chiefly carrots or corn and string beans) two or three times a week, and a small amount of cooked meat twice a week. A little salt was always kept in the cage. The cages were small.

Table 66 gives the numbers of rats weighed at the several ages and table 65 the mean values for each sex. The females were unmated. In chart 2 graph B shows the values for the males and in chart 3 graph B shows the values for the females.

The broken line record marked B′ in chart 2 gives the values found in column 2, table 65, and probably gives the truer picture for the normal weight change.

Finally at The Wistar Institute King (MS '15) has conducted two series of observations (1912–1913) (1913–1915) on the increase in body weight with age in stock Albinos. There were 23 males and 23 females in the first series and 27 of each sex in the second. The records for the two series have been combined. The observations extend from 13–485 days and the weighings were made at the ages given in table 67. These rats received a 'scrap' diet (i.e., a diet composed of table refuse from which materials known to be injurious had been removed).

In chart 2 the record for the males is given by graph C and in chart 3 the record for the females by graph C. In chart 4 the graphs for both sexes appear extended to 485 days.

In 1913 Jackson ('13) published a series of body weights for both sexes according to age, but as these animals did not grow well after about 70 days of age, the table has not been copied here.

On comparing the graphs for the males in the several series—(see chart 2) it appears that the males reared by King grew best—while in the graphs for the females (chart 3) the record by Ferry shows the poorest growth for the females. It appears therefore that laboratory conditions including diet (assumed in each case to be wholesome) may modify the growth and that the two sexes are not necessarily affected to a like degree.

4. *Modifications of growth in total body weight.* No change occurs in the growth of castrated males, Stotsenburg ('09).

A slight increase in growth was observed by Hatai ('03 a, p. 61) after lecithin feeding.

Increased growth occurs in spayed females, Stotsenburg ('13). This increase is in part due to the accumulation of fat and in part to general enlargement.

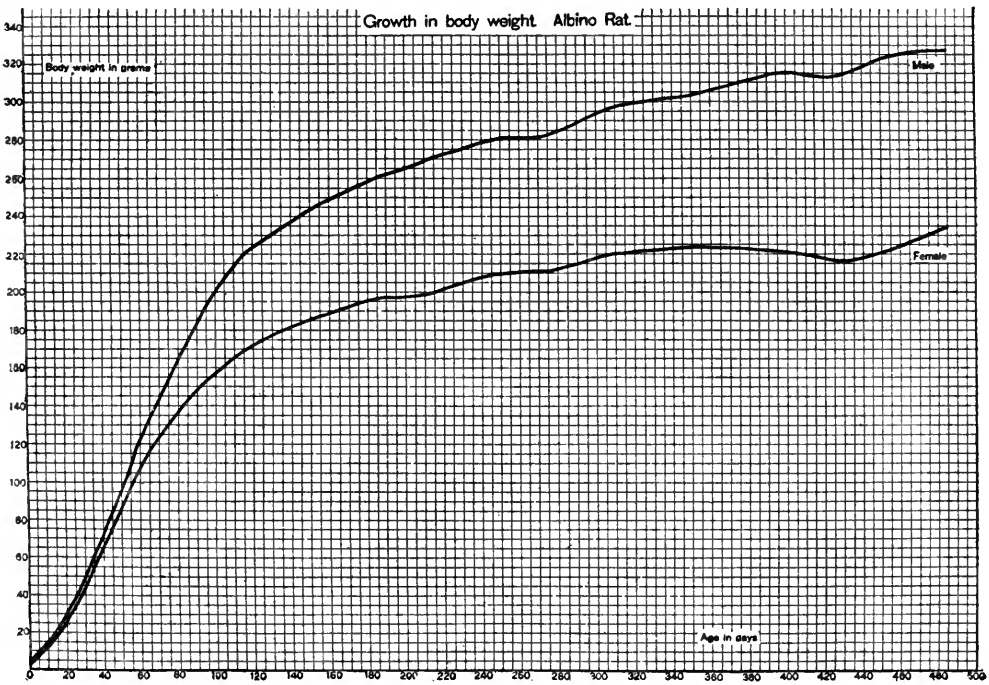

Chart 4 Growth in body weight on age for 485 days. Males and females. Observations by King (MS., '15). Data from two series combined. See table 67.

Bearing young also causes an increase in body weight in the females, J. B. Watson ('05).

A decrease follows all forms of underfeeding (Hatai, '04 a, '07 a, '08; Donaldson, '11 a) including feeding with certain vegetable proteins. See many references to Osborne and Mendel in chapter 4, Physiology: Nutrition, p. 61.

Decrease also follows an excessive meat diet when begun with young animals (Mus norvegicus) (C. Watson, '06, '06 a, '06 b).

TABLE 48

Giving in grams the values obtained by dividing the body weight by body length in millimeters. Based on data in Table 68

BODY LENGTH	RATIO		BODY LENGTH	RATIO		BODY LENGTH	RATIO	
	Male	Female		Male	Female		Male	Female
50	0.10	0.10	86	0.22	0.23	121	0.37	0.39
51	0.10	0.10	87	0.23	0.24	122	0.37	0.39
52	0.10	0.10	88	0.23	0.24	123	0.38	0.40
53	0.10	0.11	89	0.23	0.24	124	0.38	0.40
54	0.10	0.11	90	0.24	0.25	125	0.39	0.41
55	0.11	0.11				126	0.39	0.41
56	0.11	0.12	91	0.24	0.25	127	0.40	0.42
57	0.11	0.12	92	0.24	0.26	128	0.40	0.43
58	0.12	0.12	93	0.25	0.26	129	0.41	0.43
59	0.12	0.13	94	0.25	0.27	130	0.41	0.44
60	0.13	0.13	95	0.26	0.27			
			96	0.26	0.27	131	0.42	0.44
61	0.13	0.14	97	0.26	0.28	132	0.42	0.45
62	0.13	0.14	98	0.27	0.28	133	0.43	0.45
63	0.14	0.14	99	0.27	0.29	134	0.43	0.46
64	0.14	0.15	100	0.28	0.29	135	0.44	0.47
65	0.14	0.15				136	0.44	0.47
66	0.15	0.16	101	0.28	0.30	137	0.45	0.48
67	0.15	0.16	102	0.28	0.30	138	0.46	0.48
68	0.16	0.16	103	0.29	0.30	139	0.46	0.49
69	0.16	0.17	104	0.29	0.31	140	0.47	0.50
70	0.16	0.17	105	0.30	0.31			
			106	0.30	0.32	141	0.47	0.50
71	0.17	0.18	107	0.30	0.32	142	0.48	0.51
72	0.17	0.18	108	0.31	0.33	143	0.48	0.52
73	0.17	0.18	109	0.31	0.33	144	0.49	0.52
74	0.18	0.19	110	0.32	0.34	145	0.50	0.53
75	0.18	0.19				146	0.50	0.54
76	0.18	0.19	111	0.32	0.34	147	0.51	0.54
77	0.19	0.20	112	0.33	0.34	148	0.52	0.55
78	0.19	0.20	113	0.33	0.35	149	0.52	0.56
79	0.19	0.21	114	0.34	0.35	150	0.53	0.56
80	0.20	0.21	115	0.34	0.36			
			116	0.34	0.36	151	0.54	0.57
81	0.20	0.21	117	0.35	0.37	152	0.54	0.58
82	0.21	0.22	118	0.35	0.37	153	0.55	0.58
83	0.21	0.22	119	0.36	0.38	154	0.56	0.59
84	0.21	0.23	120	0.36	0.38	155	0.56	0.60
85	0.22	0.23				156	0.57	0.61

TABLE 48—Concluded

BODY LENGTH	RATIO		BODY LENGTH	RATIO		BODY LENGTH	RATIO	
	Male	Female		Male	Female		Male	Female
157	0.58	0.61	188	0.84	0.90	219	1.22	1.32
158	0.58	0.62	189	0.85	0.91	220	1.24	1.34
159	0.59	0.63	190	0.86	0.92			
160	0.60	0.64				221	1.25	1.36
			191	0.87	0.94	222	1.27	1.38
161	0.60	0.65	192	0.88	0.95	223	1.28	1.40
162	0.61	0.65	193	0.89	0.96	224	1.30	1.41
163	0.62	0.66	194	0.90	0.97	225	1.32	1.43
164	0.63	0.67	195	0.91	0.98	226	1.33	1.45
165	0.63	0.68	196	0.92	1.00	227	1.35	1.47
166	0.64	0.69	197	0.94	1.01	228	1.37	1.49
167	0.65	0.70	198	0.95	1.02	229	1.38	1.51
168	0.66	0.70	199	0.96	1.03	230	1.40	1.52
169	0.67	0.71	200	0.97	1.05			
170	0.67	0.71				231	1.42	1.54
			201	0.98	1.06	232	1.44	1.56
171	0.68	0.72	202	0.99	1.07	233	1.45	1.58
172	0.69	0.73	203	1.01	1.09	234	1.47	1.60
173	0.70	0.75	204	1.02	1.10	235	1.49	1.62
174	0.71	0.76	205	1.03	1.11	236	1.51	1.64
175	0.72	0.77	206	1.04	1.13	237	1.53	1.67
176	0.73	0.78	207	1.06	1.14	238	1.55	1.69
177	0.73	0.79	208	1.07	1.16	239	1.56	1.71
178	0.74	0.80	209	1.08	1.17	240	1.58	1.73
179	0.75	0.81	210	1.10	1.19			
180	0.76	0.82				241	1.60	1.75
			211	1.11	1.20	242	1.62	1.78
181	0.77	0.83	212	1.12	1.22	243	1.64	1.80
182	0.78	0.84	213	1.14	1.23	244	1.67	1.82
183	0.79	0.85	214	1.15	1.25	245	1.69	1.84
184	0.80	0.86	215	1.17	1.26	246	1.71	1.87
185	0.81	0.87	216	1.18	1.28	247	1.73	1.89
186	0.82	0.88	217	1.19	1.29	248	1.75	1.92
187	0.83	0.89	218	1.21	1.31	249	1.77	1.94
						250	1.79	1.97

5. *Weight-length ratios.* Although it is not our purpose to introduce derived values among the tables, yet it seemed desirable in this connection to put in a table showing the ratio of body weight to body length. This gives the weight value of a running millimeter of the animal. By the use of this table it can be de-

termined whether a given rat is emaciated or fat. The values for the weights and lengths as given in table 68 have been used for obtaining these ratios.

GROWTH IN TOTAL WEIGHT: REFERENCES

2. *Growth before birth.* Huber, '15 a. 3. *Growth after birth.* Chisolm, '11. Donaldson, '06, '12 c. Dunn, '08. Ferry, '13. Jackson, '13. King, '15. King and Stotsenburg, '15. Robertson, '08. 4. *Modifications of growth.* Donaldson, 11 a. Hatai, '03 a. '04 a, '07 a, '08, '13 a, '15. Jackson, '15, '15 a, '15 b. Osborne and Mendel (See Physiology: Nutrition). Schäfer, '12. Stotsenburg, '09, '13. Watson, C., '06, '06 a, '06 b. Watson, J. B., '05.

CHAPTER 6

GROWTH OF PARTS AND SYSTEMS OF THE BODY IN WEIGHT

1. Larger divisions. 2. Systems. 3. Teeth. 4. Blood. 5. Fat.

1. *Larger divisions.* The relative growth of the component parts (head, trunk and limbs) and of the systems (integument ligamentous skeleton, musculature and viscera) has been studied by Jackson and Lowrey ('12).

The rats were reared at the University of Missouri and fed daily with wheat bread soaked in whole milk—a supply of chopped corn being kept constantly in the cages. In addition fresh beef was given once a week. The rats were well grown except at five months and one year, when both sexes were somewhat low in body weight—the deficiency being most marked in the females.

The report of the work by Jackson and Lowrey ('12) is given largely in their own words.

The method of dissection was as follows. The animal was taken in the morning before feeding and killed by chloroform. The gross body weight, and the lengths of body and tail were recorded. The head (with skin) was then removed (just posterior to the foramen magnum and anterior to the larynx) and weighed. In the meantime, the trunk was suspended and the blood (unmeasured) was allowed to escape. Then the viscera were carefully removed and weighed individually (including brain, spinal cord, eyeballs, thyroid, thymus, heart, lungs, liver, spleen, stomach and intestines, both with contents and empty, suprarenals, kidneys and gonads). Urine was estimated if present. The extremities were separated at the shoulder and hip joints and weighed with skin. The skin (including ears, claws and adherent subcutaneous tissue) was next removed and weighed. The trunk weight was estimated by substracting the weight of the head and extremities from the net body weight.

Then the musculature with skeleton was weighed, the few remaining additional structures(genitalia, large vessels, pharynx and oesophagus, larynx and trachea, and masses of fat connected with the musculature) having been carefully removed. Finally the musculature was care-

fully dissected off and the skeleton, including bones, cartilages and ligaments, was weighed. This weight, subtracted from that of the skeleton and musculature together, gives the weight of the musculature, including the tendons. Evaporation was reduced to a minimum by keeping the various structures in a closed moist container, so far as possible. *The net body weight, which is the gross body weight minus contents of stomach, intestines and urinary bladder, was used as the basis in calculating the percentage weights.* The percentages therefore differ slightly from those calculated upon the gross body weight. The difference is not of material importance in the case of the albino rat, however, as the intestinal and other contents do not average more than 5 per cent of the body at the ages observed (excepting at 6 weeks, where the average was about 8 per cent.) The observations were grouped at seven ages, chosen for the following reasons. At one week the weight at birth has about doubled. At three weeks it has about doubled again, and this moreover is the age at which the animal is usually weaned. At six weeks the body weight has again about doubled, and the animal is well established upon its permanent diet. Ten weeks represents the age of puberty, and the body weight of six weeks has again about doubled. At one year the body weight has again nearly doubled, and this represents nearly the adult weight. Five months was arbitrarily selected as the time when the body weight is approximately half way between those of ten weeks and one year. While therefore observations are not available for the various intermediate age periods, these are sufficiently close together so that no important change in the relative weights of the constituent parts is likely to be overlooked. Moreover, on account of the variations at the different ages in the body weights, these form a fairly continuous series; and the relative weights of the various constituent parts are apparently more closely correlated with the body weight than with the age.

The relative weights of the component parts examined are given in table 49 (modified from table 2, p. 455, loc. cit.).

TABLE 49

Albino rat—Average percentage weight of head, trunk and extremities at various ages—sexes combined (Jackson and Lowrey, '12)

AGE, DAYS	BODY WEIGHT	HEAD	FORE-LIMBS	HIND-LIMBS	TRUNK
	gms.	*per cent*	*per cent*	*per cent*	*per cent*
0	5.4	21.65	7.39	9.45	61.51
7	11.6	23.70	8.92	11.97	55.41
21	25.5	20.22	9.25	14.87	55.66
42	79.2	11.80	6.72	14.94	66.54
70	141.9	9.56	5.32	15.59	69.53
150	190.7	9.42	5.87	15.64	69.07
365	222.2	9.29	4.76	14.63	71.32

The authors call attention to the relative increase in the weight of the head during the first week—as peculiar in the rat—and also point out that the maximum relative weight is shown by the head at one week—by the forelimbs at three weeks, by the hind limbs at five months and by the trunk at a year—the wave of most active growth thus passing from the head caudad with advancing age.

2. *Systems.* The relative growth of the various systems is also given for the integument, ligamentous skeleton, musculature and viscera. The method of preparing each system has been previously noted. The following table is based on table 4 (loc. cit., p. 460) to which has been added the average values of the net body weights.

It is to be noted that the percentages in tables 49 and 50 are based on the 'net body weight' of the rats. According to Jackson and Lowrey this is about 95 per cent of the gross weight, and this factor can be used therefore to transform net into gross weight.

TABLE 50

Average percentage weights of integument, ligamentous skeleton, musculature, viscera and remainder. Based on Jackson and Lowrey ('12), table 4. For the corresponding absolute weights see table 51

AGE IN DAYS	SEX AND NUMBER	BODY WEIGHT	PERCENTAGE VALUES—SEXES COMBINED FOR				
			Integument	Ligamentous skeleton	Musculature	Viscera	Remainder
		gms.					
0	M. 9, F. 9	4.7	19.8	17.3	24.4	18.1	20.4
7	M. 8, F. 11	10.1	25.9	18.5	22.8	19.2	13.6
21	M. 7, F. 6	24.8	22.4	16.6	26.9	21.3	12.8
42	M. 6, F. 8	64.5	20.9	14.0	32.7	20.4	12.0
70	M. 5, F. 5	130.5	18.7	11.7	41.1	16.0	12.5
150	M. 6, F. 7	184.3	18.1	11.5	42.6	14.8	13.0
365	M. 4, F. 2	234.6	18.0	10.9	45.4	13.3	12.4

TABLE 51.

Shows for the series of body weights of the albino rat by Jackson and Lowrey ('12) the absolute weights of integument, ligamentous skeleton, musculature, viscera and remainder determined by the use of the percentage values given in the preceding table 50

AGE IN DAYS	MEAN BODY WEIGHTS	SEX NO.	INTEGUMENT	LIGAMENTOUS SKELETON	MUSCULATURE	VISCERA	REMAINDER
			gms.	gms.	gms.	gms.	gms.
0	Average M. + F.						
	5.11	M. 9	1.00	0.87	1.19	0.90	1.15
	4.27	F. 9	0.85	0.75	1.09	0.79	0.79
	4.69		0.93	0.81	1.15	0.85	0.97
7	10.47	M. 8	2.79	1.93	2.40	2.00	1.36
	9.83	F. 11	2.33	1.70	2.24	1.90	1.30
	10.10		2.62	1.87	2.30	1.94	1.37
21	26.91	M. 7	6.35	4.20	7.45	5.71	3.23
	22.31	F. 6	4.69	3.97	5.78	4.77	3.08
	24.78		5.55	4.11	6.67	5.28	3.17
42	60.10	M. 6	12.14	9.08	19.41	12.86	6.67
	67.80	F. 8	14.51	8.95	22.37	13.36	8.61
	64.50		13.48	9.03	21.09	13.16	7.74
70	143.60	M. 5	26.14	15.94	57.15	23.26	21.11
	117.50	F. 5	22.56	14.34	49.94	18.68	11.99
	130.50		24.40	15.27	53.64	20.88	16.31
150	218.70	M. 6	41.99	22.84	93.38	29.96	25.52
	154.80	F. 7	26.62	18.73	65.94	24.30	19.20
	184.30		33.36	21.38	78.51	27.28	23.77
365	260.20	M. 4	44.75	25.50	120.99	33.83	35.13
	183.50	F. 2	35.78	24.22	79.46	25.32	18.72
	234.60		42.23	25.57	106.51	31.20	29.09

Ligamentous skeleton. Since the values for the skeleton as given in tables 50 and 51 were obtained by dissection of the soft parts from the bones, it is evident that these determinations for the skeleton, which here corresponds to the 'ligamentous skeleton' would be high as compared with those obtained after the soft parts had been completely removed by maceration—thus giving the 'cartilaginous skeleton' in the strict sense.

In view of this difference we have made recently a series of determinations of the relative weight of the cartilaginous skeleton after maceration, Conrow (MS '15). Using these determinations as a basis, table 52 has been formed which gives the values thus

obtained. The differences between the values for the moist skeleton after maceration and those obtained after gross dissection may be designated as values for the 'periosteum, ligaments, etc.' and are so entered in table 52.

It is thus possible from these two tables to compare subsequent determinations of the skeleton after either dissection or maceration.

If rats normal in body weight for their age are compared, we find that the cartilaginous skeleton at birth represents 52.5 per

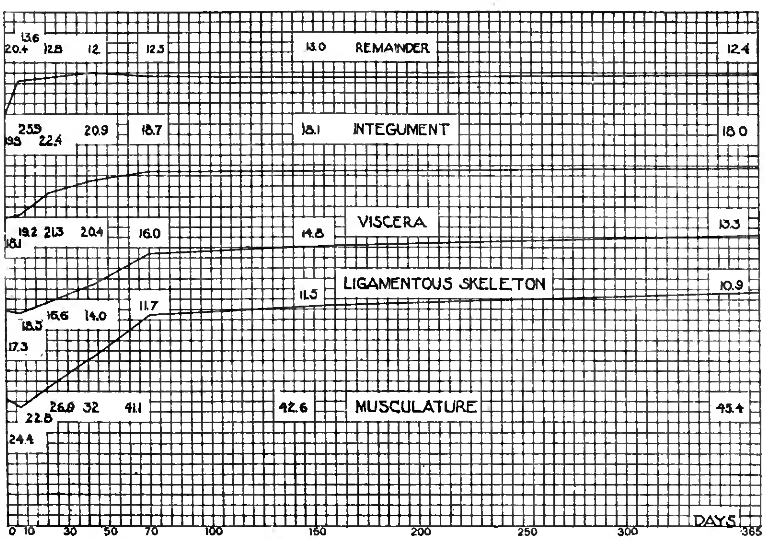

Chart 5 Giving for the sexes combined the percentage of the entire body weight represented by each of the several systems. Plotted on age in days. Table 50, Jackson and Lowrey ('12).

cent of the weight of the ligamentous skeleton, while at one year it represents 64.5 per cent. The ratio for the weight of the bony skeleton rises therefore one point for each .23 grams increase in body weight, or for each gram of increase in body weight the ratio rises about 0.044 of a point. Within the age limits here given, these factors may be used for transforming one set of values into the other.

Jackson and Lowrey conclude (p. 472) that the data indicate no noteworthy differences between the sexes in the relative weights of the various parts and systems, and that the body of the albino rat has practically reached the adult proportions in its component parts and systems at the age of ten weeks.

Corresponding observations, though less extensive, made on the Norway rat are given in chapter 12.

TABLE 52

Giving the percentage values for the cartilaginous skeleton when this has been prepared by maceration (Conrow, MS. '15), also giving—by difference between these values and those in table 50—the percentage values for the "periosteum, ligaments, etc."

AGE IN DAYS	SEX AND NUMBER	BODY WEIGHT NET BOTH SEXES	PERCENTAGE VALUE OF MOIST: Cartilaginous skeleton (by maceration) Conrow	PERCENTAGE VALUE OF MOIST: Periosteum ligaments, etc. Based on table 50
0	M. 9, F. 9	4.7	8.95	8.35
7	M. 8, F. 11	10.1	9.36	9.14
21	M. 7, F. 6	24.8	9.61	6.99
42	M. 6, F. 8	64.5	7.46	6.54
70	M. 5, F. 5	130.5	7.32	4.38
150	M. 6, F. 7	184.3	6.32	4.18
365	M. 4, F. 2	234.6	6.04	4.05

Weight of entire cartilaginous skeleton. Using a 2 per cent solution of the commercial gold dust washing powder ('Gold dust washing powder' consists of about 45 per cent sodium carbonate, 30 per cent soap powder, and 25 per cent water), the skeletons of some 70 inbred Albinos (King) have been carefully prepared by Conrow (MS '15) at The Wistar Institute. The animals were reared on a scrap diet. A careful comparison with the stock Albinos has not yet been made, but at the same time there is no suggestion thus far that the values for the inbreds differ from

those for the stock, when both age and body weight are taken into consideration. The weight of the skeleton is given in relation to the body weight. The value for the body used here is that normal to the body length (see table 68) when the observed body weight is less than that to be expected—but the observed body weight is used when that is above the normal for the body length. In the case of old rats undergoing senile loss of body weight the *maximum body weight* is the one used.

The weight of the teeth is included with that of the skeleton—but the weight of the nails is excluded. Under these conditions the following table gives the weight of the moist cartilaginous skeleton—immediately after complete cleaning, and also

TABLE 53

Giving data on the cartilaginous skeleton of the (inbred) Albino (Conrow MS '15). The weights for the moist skeleton are given—but not for the room dried skeleton. The percentage values for both on the body weight have been computed.

SEX	AGE IN DAYS	BODY LENGTH	BODY WEIGHT	SKELETON WEIGHT MOIST	PERCENTAGE VALUE OF	
					Moist skeleton	Dry skeleton
		mm.	*gms.*			
M	New born	45	4.0	0.379	9.38	1.78
M	New born	47	4.0	0.401	10.03	2.35
F	New born	47	4.7	0.351	7.43	1.70
M	4	58	6.8	0.791	11.59	2.48
M	2	59	7.1	0.986	13.85	3.51
M	3	59	7.1	0.613	8.59	2.24
M	11	65	9.4	0.909	9.63	2.47
F	10	65	9.9	0.904	9.09	2.67
F	17	76	14.8	1.469	9.89	3.61
F	20	90	22.4	2.114	9.40	3.59
F	22	102	30.5	3.005	9.82	3.81
M	28	103	29.6	2.543	8.56	3.91
M	29	113	37.3	3.301	8.82	3.91
M	33	118	41.6	3.532	8.46	3.72
M	34	123	46.3	4.030	8.73	4.06
M	32	125	48.3	3.965	8.18	3.84
F	41	126	52.3	3.959	7.54	3.89
M	40	131	54.7	4.374	7.97	3.85
M	36	133	56.9	4.662	8.16	3.74
M	43	135	59.3	4.620	7.76	3.89
F	46	140	69.5	4.997	7.16	4.03

TABLE 53—Concluded

SEX	AGE IN DAYS	BODY LENGTH	BODY WEIGHT	SKELETON WEIGHT MOIST	PERCENTAGE VALUE OF Moist skeleton	PERCENTAGE VALUE OF Dry skeleton
		mm.	gms.			
F	73	145	76.7	5.930	7.70	4.84
F	54	148	81.3	6.349	7.78	4.34
F	102	153	89.4	7.278	8.12	5.20
F	84	164	109.9	8.114	7.36	4.79
F	117	164	109.9	7.424	6.74	4.58
F	106	171	125.0	8.876	7.08	4.72
F	189	172	127.3	9.665	7.57	5.36
F	119	181	149.7	10.209	6.80	4.77
F	120	183	155.2	9.983	6.41	4.43
F	135	185	160.8	11.155	6.92	4.56
M	99	185	149.6	10.609	7.07	5.03
M	105	186	152.3	10.539	6.90	4.74
F	125	188	169.6	11.469	6.74	4.79
F		190	175.7	11.888	6.75	5.00
F	320	196	223.0	13.386	5.98	4.00
M	173	197	184.3	11.283	6.10	4.00
F	281	199	205.8	13.132	6.36	4.64
M	253	199	190.8	12.557	6.56	4.82
M	196	200	194.1	12.409	6.38	4.53
F	299	202	216.8	14.378	6.62	4.57
F	302	203	220.7	13.974	6.32	4.69
F	392	203	220.7	12.911	5.84	3.56
M	121	207	218.7	13.594	6.22	4.37
M	203	211	234.1	14.600	6.23	4.21
M	371	211	295.0	15.019	5.08	3.42
M	169	214	246.3	15.543	6.30	4.52
M	205	215	250.5	15.688	6.25	4.58
M	304	216	307.0	16.810	5.47	3.76
M	367	219	318.0	19.321	6.07	4.26
M	221	219	267.9	16.158	6.02	4.09
M	314	221	344.0	20.078	5.83	4.05
M	462	223	342.9	20.277	5.90	4.22
M	357	225	410.0	19.147	4.66	3.47
M	518	226	343.0	20.433	5.95	4.29
M	332	226	419.0	22.257	5.30	3.93
M	474	228	355.0	19.518	5.49	3.88
M	276	228	413.0	22.323	5.40	3.96
M	726	230	446.0	21.720	4.86	3.55
M	255	238	420.0	25.390	6.04	4.49
M	253	240	440.0	23.698	5.38	4.01
M	408	252	463.4	23.823	5.03	3.79

the weight of the dry skeleton after drying in open, but dust free vessels, for thirty days or more at room temperature (17°–23°C.).

In table 54 the same material has been used to show the lengths of the femur and tibia and the humerus and ulna together with some simple relations. In the case of the Albinos less than 30 days of age, drying in the air may cause so considerable a reduction in the lengths of these bones that no measurements are given in table 54 for dried long bones younger than 30 days—at which time the skeleton is fairly well calcified.

TABLE 54

From some of the same (inbred) Albinos as were used for table 53 the lengths of the femur, tibia, humerus and ulna have been determined and also the percentage lengths of the humerus and ulna on the femur and tibia, as well as the relation of both of these pairs to the body length (Conrow, MS '15)

SEX	AGE DAYS	BODY LENGTH	MEAN LENGTHS IN mm. OF				PERCENTAGES OF		
			Femur	Tibia	Humerus	Ulna	$\frac{H.+U.}{F.+T.}$	$\frac{F.\ T.}{Bd.\ L.}$	$\frac{H.\ U.}{Bd.\ L.}$
		mm.							
M.....	32	125	18.7	23.0	15.9	18.8	83	33	27
F......	41	126	18.7	23.0	15.4	18.3	80	33	26
M.....	40	131	18.2	22.9	15.4	18.7	82	31	26
M.....	36	133	20.9	25.0	16.9	20.2	80	34	28
M.....	43	135	19.8	23.6	16.0	18.9	80	32	25
F......	46	140	21.2	24.6	17.1	19.7	80	32	26
F......	73	145	23.1	26.4	17.8	21.4	79	34	27
F......	54	148	23.5	27.4	18.4	22.0	79	34	27
F......	102	153	25.3	29.3	20.5	23.6	80	35	28
F.....	84	164	26.1	29.8	20.7	24.6	81	34	27
F......	117	164	27.3	31.5	21.3	25.7	79	35	28
F......	106	171	27.8	31.5	22.1	25.8	80	34	28
F......	189	172	28.8	32.2	22.6	26.8	80	35	28
F......	119	181	30.3	33.0	23.6	27.1	80	34	27
F......	120	183	29.0	32.9	22.7	27.1	80	33	27
M.....	119	183	30.7	33.6	23.9	26.6	78	35	27
F......	135	185	31.5	34.6	24.6	28.3	80	35	28
M.....	99	185	30.6	34.0	23.9	27.1	78	34	27
M.....	105	186	30.8	33.8	24.1	27.4	79	34	27
F......	125	188	30.6	33.8	23.6	28.1	80	34	27
F......		190	30.7	34.6	24.4	28.6	81	34	27
F......	730	193	33.5	36.5	26.3	31.5	82	35	29

TABLE 54—Concluded

SEX	AGE DAYS	BODY LENGTH	MEAN LENGTHS IN mm. OF				PERCENTAGES OF		
			Femur	Tibia	Humerus	Ulna	$\frac{H.+U.}{F.+T.}$	$\frac{F.\ T.}{Bd.\ L.}$	$\frac{H.\ U.}{Bd.\ L.}$
		mm.							
F......	320	196	34.8	36.5	26.8	30.5	80	36	29
M.....	173	197	32.8	35.6	25.5	28.9	79	34	27
M.....	253	199	34.3	37.4	26.8	31.4	81	35	29
F......	281	199	32.9	36.5	25.9	30.8	81	34	28
M.....	196	200	33.9	36.9	26.3	30.3	79	35	28
F......	392	203	32.1	35.1	25.0	29.3	80	33	26
F......	302	203	34.5	37.8	26.6	31.9	80	35	28
M.....	121	207	34.1	36.9	26.7	30.2	80	34	27
M.....	203	211	34.6	38.6	26.9	31.6	79	34	27
M.....	371	211	37.0	39.2	28.3	32.5	79	36	28
M.....	169	214	35.0	37.3	27.3	30.7	80	33	27
M.....	205	215	35.1	37.7	27.1	31.3	80	33	27
M.....	304	216	37.9	41.7	29.8	34.6	81	36	29
M.....	221	219	37.5	39.8	28.7	32.3	78	35	27
M.....	367	219	37.3	38.6	28.9	31.8	79	34	27
M.....	314	221	38.6	40.4	29.9	34.1	81	35	28
M.....	462	223	37.3	39.2	29.4	32.1	80	34	27
M.....	357	225	39.2	41.5	30.5	34.1	80	35	28
M.....	518	226	37.7	39.2	29.6	32.4	80	34	27
M.....	332	226	38.2	41.5	29.6	34.6	80	35	28
M.....	276	228	38.3	39.7	29.8	32.5	79	34	27
M.....	474	228	40.0	41.3	30.9	34.2	80	35	28
M.....	726	230	39.2	40.9	30.5	33.1	79	34	27
M.....	255	238	39.6	42.5	30.7	35.9	81	34	27
M.....	253	240	40.7	43.8	32.0	36.0	80	35	28
M.....	408	252	41.0	43.1	31.7	36.1	80	33	26

Tests show that after 30 days of age, drying at room temperature causes less than one per cent of shrinkage in the absolute lengths of the bones. The values for the bone lengths given in the table are means for the right and left sides—the length for the two sides usually being very nearly the same. The body length in every case is taken on the rat immediately after chloroforming.

Weight of cranium. Determinations of the weight of the cranium dried at room temperature have been made, Donaldson ('12 a). By the cranium is meant the skull with upper

teeth, minus the mandible with lower teeth and minus the ear bones. The mean weights are given in table 55.

TABLE 55

The mean weight in grams of the crania in each body weight group of the four series of albino rats from Paris, London, Philadelphia, Vienna (based on table 4) Donaldson ('12 a). Each weight group is based on six cases, three males and three females

BODY WEIGHT GROUP	WEIGHT OF CRANIA IN GRAMS			
	London	Paris	Philadelphia	Vienna
grams				
125	0.89	1.03	1.05	1.00
175	1.23	1.27	1.41	1.40
225	1.52	1.52	1.51	1.73
275	1.79		1.87	2.10
325			2.15	

For the corresponding weights of the Norway crania see Table 84.

3. *Teeth.* For the data on the growth of the incisor teeth (Addison and Appleton, '15), see chapter 3, p. 37–39.

4. *Blood.* By means of a formula (19) based on his observations Chisolm ('11) was able to compute approximately the volume of the blood in rats of different body weights. Hatai (MS '14) has added two formulas (19 a) (19 b) based on that of Chisolm and giving results somewhat closer to the observations when the determinations are made according to sex.

These three formulas have been transformed in turn from volume to weight by using as a factor 1.056—the specific gravity of the blood—and three formulas for blood weight (20) (20 a) (20 b) have been thus obtained. These last have been used to compute the weight of the blood as given in table 70. Table 56 here given presents Chisolm's data on the other growth changes in the blood.

5. *Fat.* Boycott and Damant ('08, '08 a) have recorded the proportion of fat in rats of both sexes and of increasing body weights.

The total fat was determined in healthy animals living under ordinary laboratory conditions as to food. No details given. The fat was estimated by Leathes' modification of Liebermann's

TABLE 56

Showing growth changes in the blood in rats of increasing age (body weight). Sexes combined—based on tables I and II, Chisolm ('11)

NO. OF ANIMALS	AGE IN DAYS	BODY WT. IN GMS.	LENGTH OF BODY IN MM.	HB PER CENT	O_2 CAPACITY IN CC.		BLOOD VOLUME IN CC.	
					Total	Per kilo body wt.	Total	Per kilo body wt.
2	1	3.6		89.0	0.0411	11.59	0.249	70.3
5	2	4.8	47	72.0	0.0466	9.79	0.350	73.5
3	8	10.0	59	50.3	0.0485	4.83	0.522	52.0
9	16	12.8	72	63.0	0.0639	4.99	0.544	42.5
3	21	14.2	82	49.0	0.0773	5.44	0.863	60.4
3	28	14.3	84	44.7	0.0891	6.17	1.070	74.4
9		37.0	112	76.0	0.3730	10.00	2.620	70.0
8		57.0	134	84.6	0.5630	9.92	3.610	63.7
8		66.0	140	85.1	0.6490	9.88	4.120	62.7
12		75.0	144	79.9	0.7220	9.60	4.940	65.7
15		86.0	148	82.4	0.8600	10.02	5.670	66.0
8		95.0	155	84.0	0.9550	10.02	6.070	63.9
8		106.0	159	82.4	1.0270	9.74	6.810	64.5
11		115.0	166	92.5	1.2130	10.51	6.970	60.5
9		125.0	169	92.6	1.2410	9.89	7.260	57.9
8		146.0	178	89.1	1.4460	9.92	8.870	60.8
8		165.0	180	92.0	1.6630	10.10	9.890	59.3
7		194.0	189	92.4	1.9880	10.28	11.820	61.0
10		227.0	201	89.9	2.1860	9.68	13.180	58.2
8		268.0	206	85.4	2.2300	8.36	14.150	53.0

methods (see Hartley, '07) which is easily applicable to the entire carcasses of animals. The figures, given as percentages of fatty acid on the crude weight of the animal, represent therefore masked as well as anatomical fat.

From the table 57 based on body weight it appears that the proportion of fat tends to be greater in the heavier animals, and from the tables based on the data grouped according to sex, it appears that the females have a somewhat larger percentage of fat than do the males.

TABLE 57

Giving the proportion of fat (fatty acids) with increasing age (body weight.) Based on table A, Boycott and Damant ('08 a)

NUMBER AND SEX		BODY WEIGHT IN GMS.	PERCENTAGE OF FATTY ACIDS		
M.	F.		Max.	Min.	Average
15	10	20– 49	9.2	0.85	4.1
8	7	50– 99	6.1	1.00	4.0
19	25	100–149	16.1	0.80	6.1
11	17	150–199	14.6	1.30	7.6
7	2	200–247	9.7	1.30	5.8

Eighty-three rats arranged according to sex

Males 41	11.3	0.8	4.4
Females 42	16.1	1.0	5.6

GROWTH OF PARTS AND SYSTEMS: REFERENCES

1. *Larger divisions.* Jackson and Lowrey, '12. 2. *Systems.* Donaldson, '11, '11 c, '12, '12 a. Donaldson and Hatai, '11, '11 a. Jackson and Lowrey, '12. 3. *Teeth.* Addison and Appleton, '15. MacGillavry, 1875. Meyerheim, 1898. 4. *Blood* and 5. *Fat.* Boycott and Damant, '08, '08 a. Chisolm, '11. Hartley, '07.

CHAPTER 7

GROWTH OF PARTS AND ORGANS IN RELATION TO BODY LENGTH AND IN RELATION TO AGE

1. Introduction. 2. Methods of examination and graphs. 3. Body length on body weight. Body weight on body length. Tail length on body length. 4. Organs with an early rapid growth: Brain, spinal cord, eyeballs. 5. Organs with a nearly uniform growth: Heart, kidneys, liver, spleen, lungs, blood, alimentary tract, thyroid, hypophysis and suprarenals. 6. Organs with a rapid growth just preceding puberty. Ovaries, testes, thymus (on age). 7. Determinations of variation. 8. General tables. *a*) Tables, weight of entire body on age. Before birth; from birth on. *b*) Tables, increase in the length and weight of parts and organs on body length. 9. Table, weight of thymus on age. 10. Table, weight of all viscera combined. 11. Tables, values for characters linked with age. 12. Formulas.

1. *Introduction.* The organs, the growth of which has been followed are tail (length), brain, spinal cord, eyeballs, heart, kidneys, liver, spleen, lungs (blood), alimentary tract, testes, ovaries, hypophysis, suprarenals, thyroid and thymus.

All the observations were made on stock Albinos from the colony at The Wistar Institute, except those for the total blood which are based on the records of Chisolm, '11.

The mean values for the several organs were in each instance charted and with these as a guide a theoretical graph was found which could be expressed by a formula or a series of formulas. All the formulas were devised by Hatai.

To present the results in a convenient form the organs are grouped in the text according to the manner of their growth, each organ is accompanied by a chart showing the original data and the graph based on these data.

In each case reference is made to the formula or formulas on which the graph is based, but as a matter of convenience, the formulas utilized here for the graphs are grouped in the section entitled "Formulas" pp. 158-175.

The charts serve to show the form of the graph of growth in each instance, but the precise weight values of the organs are to be read from the tables. For those who desire to find the weight of an organ in a rat of any body length or body weight a series of values—computed by the aid of the appropriate formulas—are given in tables 68–71 inclusive.

In making these tables the determinations for the corresponding body weights for each millimeter of length in each sex were first made by formulas (2a) and (2b) and the body weights so obtained were then used in computing the weights of the several organs.

In table 72 for the thymus however, it was found necessary to enter the weight values of the organ according to the age of the rat.

In table 73 the computed weight of the thymus on body weight is given on the assumption that the *body weights are normal to age* in conformity with the data in table 62.

2. *Methods of examination and graphs.* Unless otherwise stated the following determinations were made on stock Albinos taken from the colony at The Wistar Institute. The animals were killed with chloroform twenty hours after the last feeding and were dissected according to a fixed procedure.

3. *Body length on body weight.* Technic: Immediately after killing the rat was laid on its back and gently extended—the tail being drawn out straight. With jointed calipers the distance from the tip of the nose to the tip of the tail was taken and its values in millimeters found by applying the points to a scale. Next the distance from the tip of the nose to the center of the anus was found and its value in millimeters determined in the same way. These measurements give first the total length, second, the body length and by the difference, the tail length.

Chart 6 gives the body length on the body weight. The data used are given in table 68. The values were computed by formula (1). The graphs show that for a given body weight the male has the greater body length. Donaldson '09; Donaldson and Hatai '11.

Body weight on body length. The entire rat was next weighed to one-tenth of a gram. The weight thus obtained was *not* corrected for the contents of the alimentary canal—which according to Jackson and Lowrey ('12) amounts to about 5 per cent of the gross body weight. In gravid females a correction was made however by subtracting the weight of the uterus and fetuses from the observed value. The weight of the body on the body

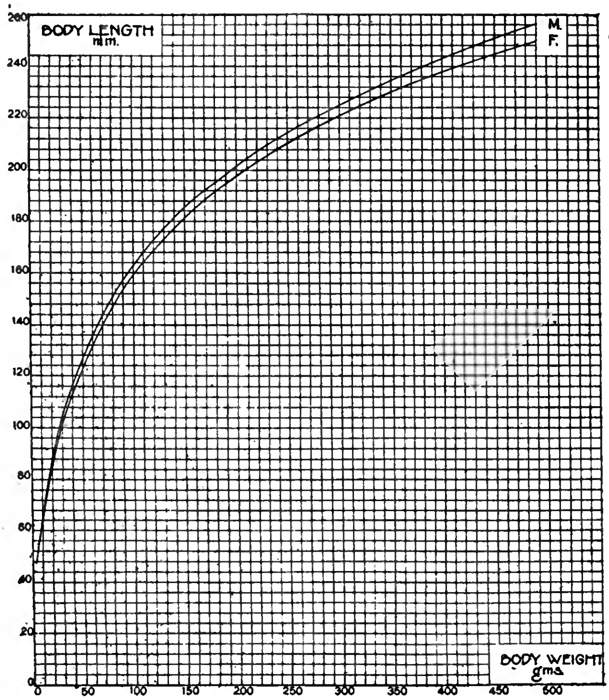

Chart 6 Giving for the males and females respectively the body length on the body weight. Formula (1), table 68.

length is given in chart 7. The values for each millimeter of body length in each sex are given in table 68. The graphs were computed by formulas (2a) and (2b), and show that for a given body length the female has a greater body weight. Donaldson '09, Donaldson and Hatai, '11.

Tail length on body length. The method of obtaining the tail length has been given under body length. The values for

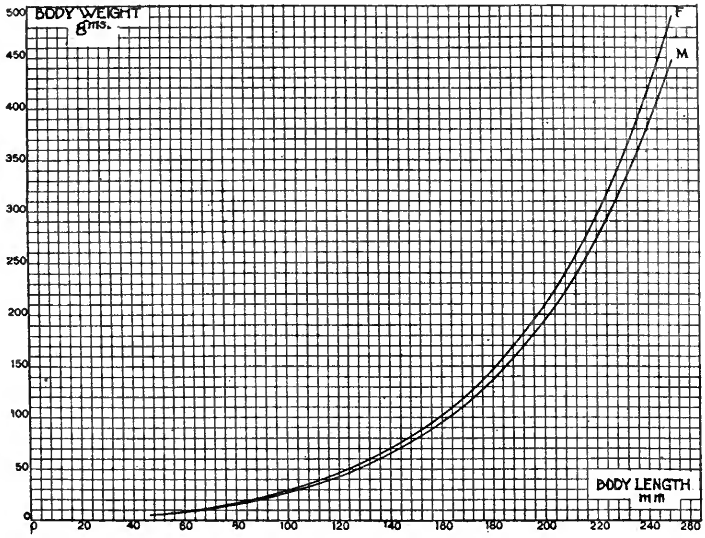

Chart 7 Giving for the males and females respectively the body weight on the body length. Formulas (2 a) and (2 b), table 68.

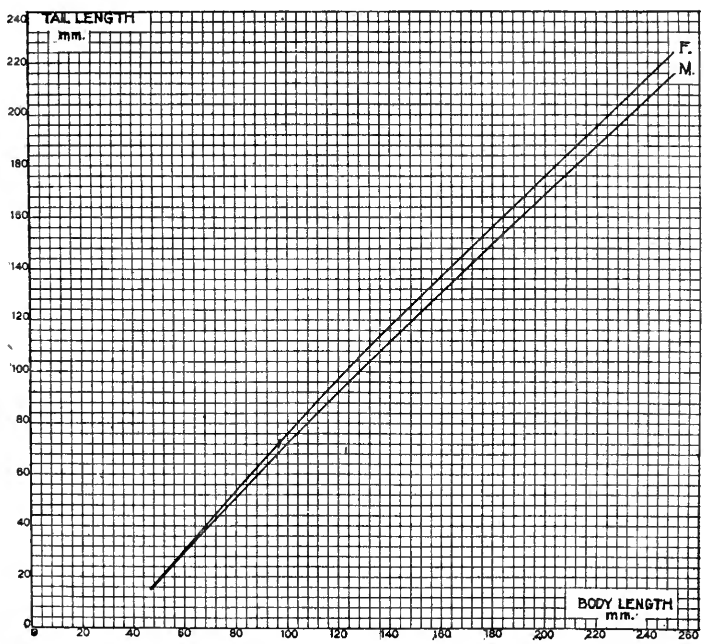

Chart 8 Giving the length of tail in millimeters on the body length, males, females. Formulas (4) and (5), table 68.

the graphs in chart 8 and for the table 68 were determined by formulas 4 and 5. The tail in the female is relatively longer than in the male. Hatai (MS '14).

4. *Following the plan of grouping the organs according to the manner of their growth we shall first consider the weights of the brain, the spinal cord and both eyeballs. All of these organs have an early rapid growth.*

Brain weight on body weight. Technic: The rat was first eviscerated—this leaves in the brain a minimal amount of blood. The bones of the skull were removed from above—the meninges being left intact. Care was taken to preserve the flocculi which lie in bony pockets. The brain was severed from the cord by a section at the level of the first cervical nerve—coinciding as a rule with the tip of the calamus as seen from the dorsal aspect. The brain was then raised from the floor of the cranium—the nerves being clipped close to the base. The hypophysis was not included. Care was taken to obtain the olfactory bulbs entire. Thus prepared the brain was dropped into a small glass stoppered weighing bottle in which it was weighed to the tenth of a milligram. In this instance, as in the case of all of the other organs, the dissection was made under a glass hood to protect the operator from all drafts which might dry the organ during its preparation. The values for the graph, males only, chart 9 and for table 68 were computed by formulas (6) and (7).

The graph for the male alone is given. As will be seen from table 68, for the same body length the female has a slightly lighter brain and this difference increases to about 1.5 per cent when the female is of the same body weight.

Spinal cord weight on body weight. Spinal cord—Technic: Following the removal of the brain (vide ante) the spinal cord was exposed by removing the arches of the vertebrae from neck to sacrum. The filum terminale was found and the cord raised—so that the roots of the spinal nerves could be clipped close to the cord. The mass thus removed with meninges—was placed in a glass stoppered weighing bottle and weighed to the tenth of a milligram. The values for the graph, males only, in chart 9 and for table 68 were computed by formula (11). Donaldson ('08), ('09); Hatai, ('09a).

For convenience the graph for the spinal cord is given on the same chart as that for the brain. The graph for the male only is entered. For the same body length as the male the spinal cord in the female is about 5 per cent heavier, and for the same body weight, about 2 per cent heavier. Donaldson ('08, '09); Hatai ('09a).

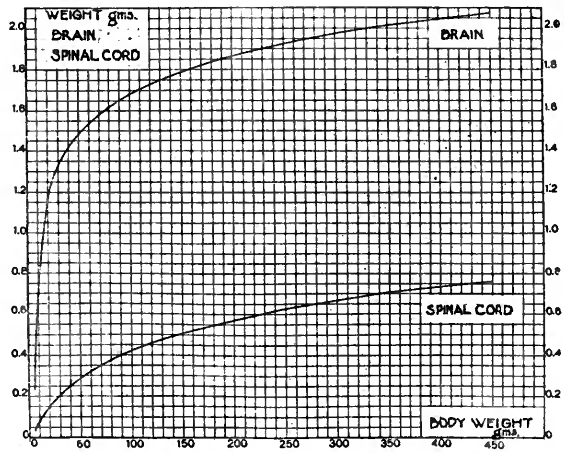

Chart 9 Giving the brain weight on the body weight. Males only. Formulas (6) and (7), table 68. Also spinal cord weight on the body weight. Males only. Formula (11), table 68.

Weight of both eyeballs on body weight. Technic: Care being taken to remove the muscle attachments, both eyes were weighed in a closed weighing bottle. There is usually a close similarity in the weight of the right and left eyeballs. The graph is based on rats studied by Jackson ('13). His results have been corroborated by studies on the stock Albinos from the colony of the Wistar Institute, Hatai ('13). The values for the graph in chart 10 and those given in table 68 are based on formula (13). The graph for the male only is entered, but the values for the female are like those for the male of the same body weight. Under unfavorable nutritional conditions the weight of the eyeballs follows the age rather than the body weight. Hatai (MS '14).

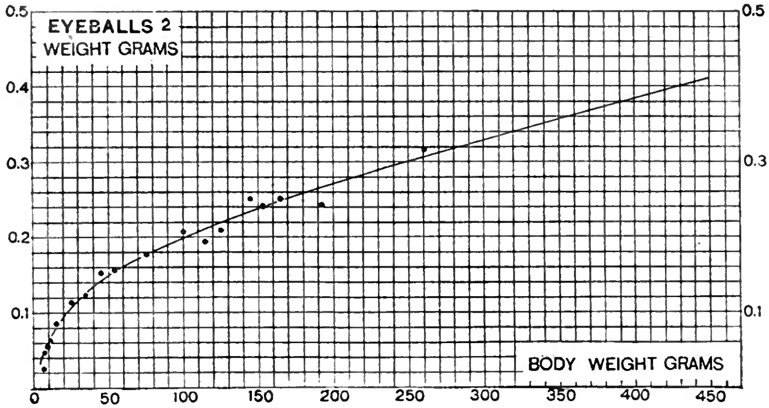

Chart 10 Showing the weight of eyeballs of the male albino rat according to body weight. The observed weights are represented by 149 male rats (Jackson). Table 68, formula (13).

● Observed weight. —— Calculated weight.

5. *Organs with a nearly uniform growth after the first very early phase of rapid growth—heart, kidneys, liver, spleen, lungs (blood), alimentary tract, hypophysis, suprarenals and thyroid.*

In case of all of the organs to be described the preparation was carried on beneath a glass hood to prevent drying. The organ was weighed in a small glass stoppered bottle and the weight was taken to a tenth of a milligram.

The weight of the heart on body weight. Technic: The heart was removed after cutting all its vessels close to their proximal ends. It was then opened by longitudinal slits through its walls and the clots removed from the cavities thus exposed.

The graph given in chart 11 and the values in table 69 have been determined by formula (14).

The weight of the heart is closely correlated with that of the body and no difference according to sex has been noted. Hatai ('13); Jackson ('13).

Weight of both kidneys on body weight. Technic: All vessels were cut close to the hilum and any superficial fat removed.

The graph given in chart 12 and the values in table 69 were determined by formula (15).

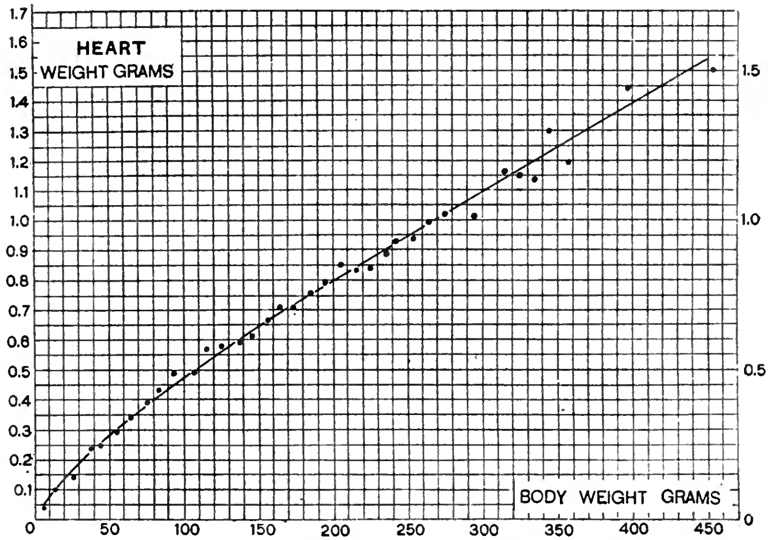

Chart 11 Showing the heart weight of the male albino rat according to body weight. The observed weights are represented by 134 male rats. Table 69, formula (14).

● Observed weight. —— Calculated weight.

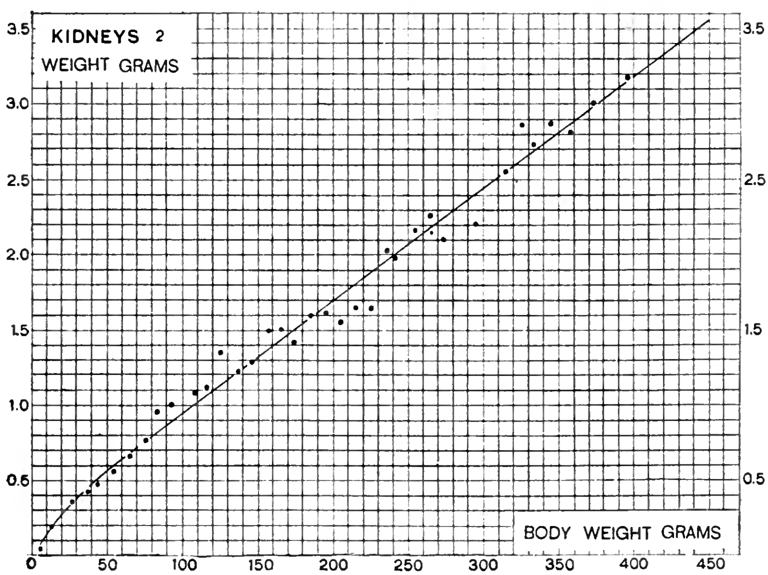

Chart 12 Showing the weight of kidneys of the male albino rat according to body weight. The observed weights are represented by 136 male rats. Table 69, formula (15).

● Observed weight. —— Calculated weight.

No sex difference was observed but the graph represents the determinations for the male only. Hatai ('13); Jackson ('13).

Weight of the liver on the body weight. Technic: The vessels were cut close to their entrance into the liver and the blood in the larger vessels gently pressed out. The graph given in chart 13 and the values in table 69 were determined by formula (16).

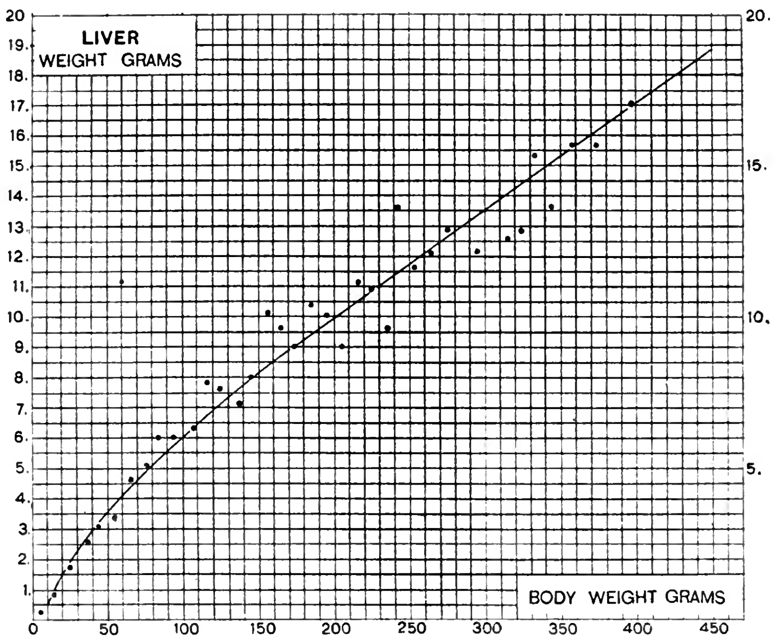

Chart 13 Showing the weight of liver of the male albino rat according to body weight. The observed weights are represented by 136 male rats. Table 69, formula (16).

● Observed weight. —— Calculated weight.

No sex difference in the weight of the liver has been noted—but the graph is given for the males only. Considerable variability is to be expected in the weight of an organ with such complex functions as those of the liver and this appears. A heavy liver usually accompanies a heavy spleen (Hatai). Hatai ('13); Jackson ('13).

The weight of the spleen on the body weight. Technic: The vessels were cut close to the hilum. The determination of the weight of the spleen is complicated by the occurrence of "enlarged spleens"—so called. These differ from the normal by being often several times the normal weight, darker in color, soft to the touch and showing on the surface dark or grayish patches. Spleens with these characters plainly marked were not used. The graph in chart 14 and the values in table 69 were determined

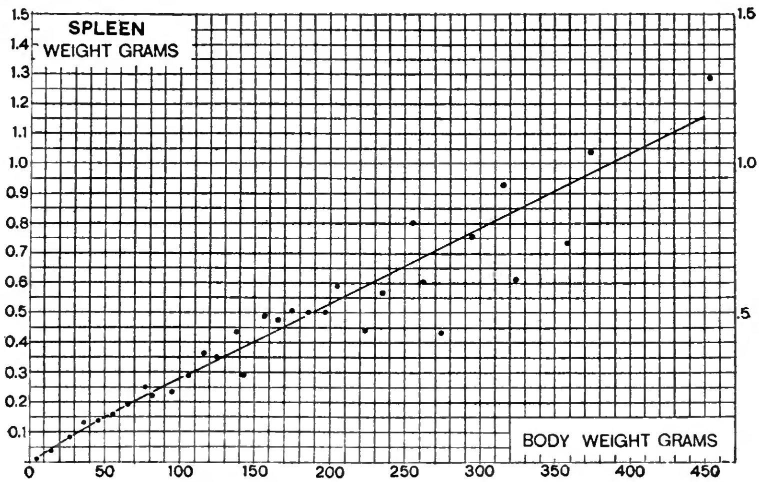

Chart 14 Showing the weight of spleen of the male albino rat according to body weight. The observed weights are represented by 87 male rats. Table 69, formula (17).

● Observed weight. —— Calculated weight.

by formula (17). No sex difference was observed but the graph is based on male records only. Hatai ('13); Jackson ('13).

The weight of both lungs on the body weight. Technic: The lungs are severed from the trachea and the portion of the esophagus usually taken out with them is removed. After the first three months of life the lungs of the rat are often infected. Such infected lungs may be highly altered—but are always abnormally heavy. The endeavor has been made to exclude infected lungs from the series—but doubtless some have been used. The graph in chart 15 and the values in table 70 were determined by

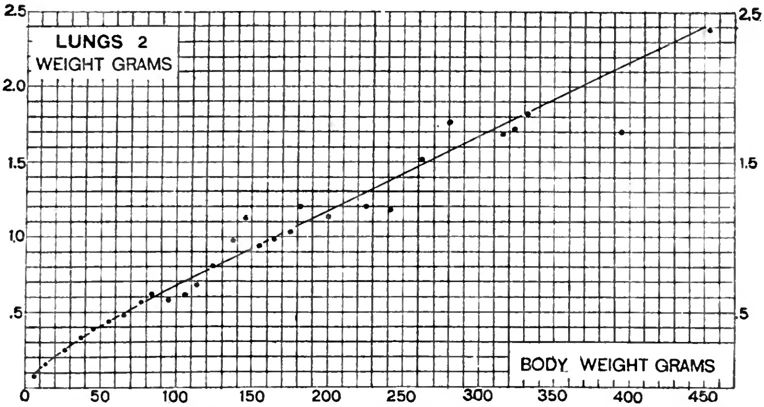

Chart 15 Showing the weight of lungs of the male albino rat according to body weight. The observed weights are represented by 90 male rats. Table 70, formula (18).
● Observed weight. —— Calculated weight.

formula (18). No sex difference has been noted but the graph is based on male data alone. Hatai ('13); Jackson ('13).

Weight of the total blood on body weight. Technic: The observations on this relation were made by Chisolm '11 on Albinos and pied rats. His methods are given in the paper cited above (pp. 207–208) and depend on determinations of the oxygen capacity. Chisolm's formulas have been revised by Hatai (MS '14). The graph in chart 16 and the values in table 70 have

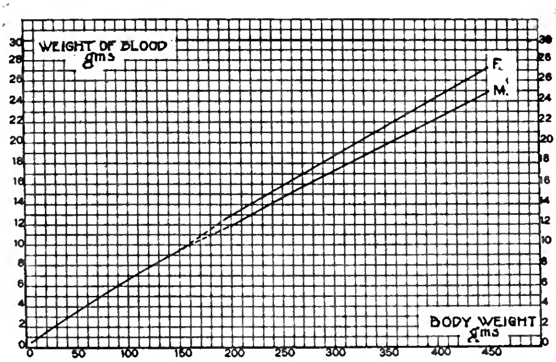

Chart 16 Giving weight of total blood on body weight. Males, females. Formulas (20), (20a), and (20b), table 70.

been determined by formulas (20), (20 a), and (20 b). The data are for both sexes combined. Chisolm ('13); Jolly and Stini ('05).

The weight of the alimentary tract on body weight. Technic: The digestive tube from the level of the diaphragm to the anus was removed in its entirety—the pancreas, mesentery and small masses of fat being left adherent. The stomach and the large intestine were cut open and the contents removed while gentle

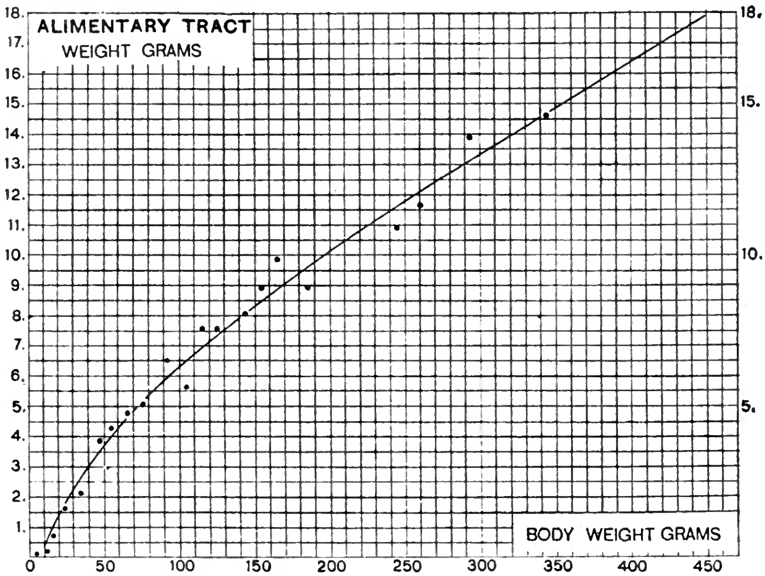

Chart 17 Showing the weight of alimentary tract of the male albino rat according to body weight. The observed weights are represented by 112 (Jackson) rats below 50 grams in body weight, and 82 (Wistar) rats above 50 grams in body weight. Table 70, formula (21).

● Observed weight. —— Calculated weight.

pressure on the small intestine—exerted from above downwards—served to expel what it contained. The records are based on one series examined by Jackson ('13) and another series from The Wistar Institute colony. All are males. The graph in chart 17 and the values in table 70 were determined by formula (21). Hatai ('13); and Jackson ('13).

Weight of the thyroid gland on body weight. Technic: Several minute muscles nearly the color of the gland must be re-

moved before weighing. The data are from observations by Jackson ('13), as well as from those made at The Wistar Institute. A study of the data has not revealed any difference according to sex and the graph therefore is for both sexes combined. The graph in chart 18 and the values in table 71 have been determined by formula (32). Hatai ('13); Jackson ('13).

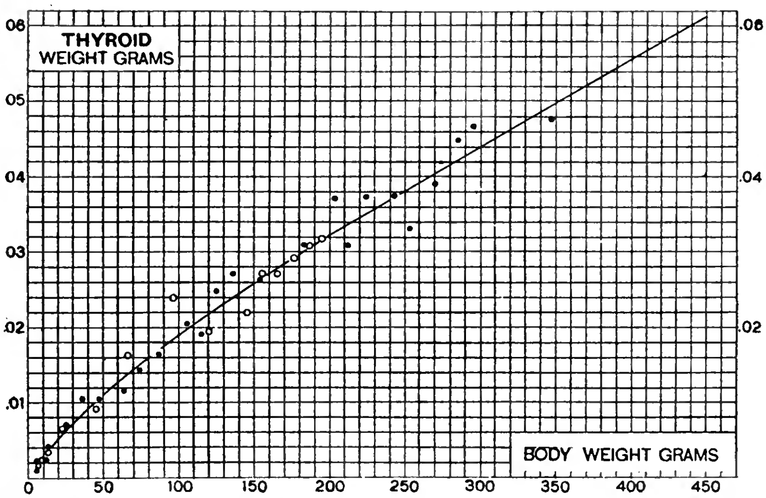

Chart 18 Showing the weight of thyroid gland of the albino rat according to body weight. The observed weights are represented by 42 (Jackson) female rats below 50 grams in body weight, and 49 (Wistar) male rats above 50 grams in body weight; and 36 (Jackson) female rats below 50 grams in body weight, and 27 (Wistar) female rats above 50 grams in body weight. Table 71, formula (32). ● Observed weight male. —— Calculated weight for both sexes. ○ Observed weight, female.

The weight of the hypophysis on body weight. Technic: After the removal of the brain, the hypophysis is readily picked up from the floor of the skull with a small forceps. It is weighed as removed.

At about 40–50 days of age there appears a difference in the weight of the hypophysis according to sex and with advancing age this difference tends to increase. The female has the heavier hypophysis. The graph for the male in chart 19 and the values for the male in table 71 have been determined by formula (28).

The graph for the female and the corresponding tabular values by formulas (28) and (29). Hatai ('13).

The weight of the suprarenals on body weight. Technic: The suprarenals are usually imbedded within some fat tissue—but with a little practice they may be dissected out cleanly. At about 40–50 days of age there appears a difference in the weight

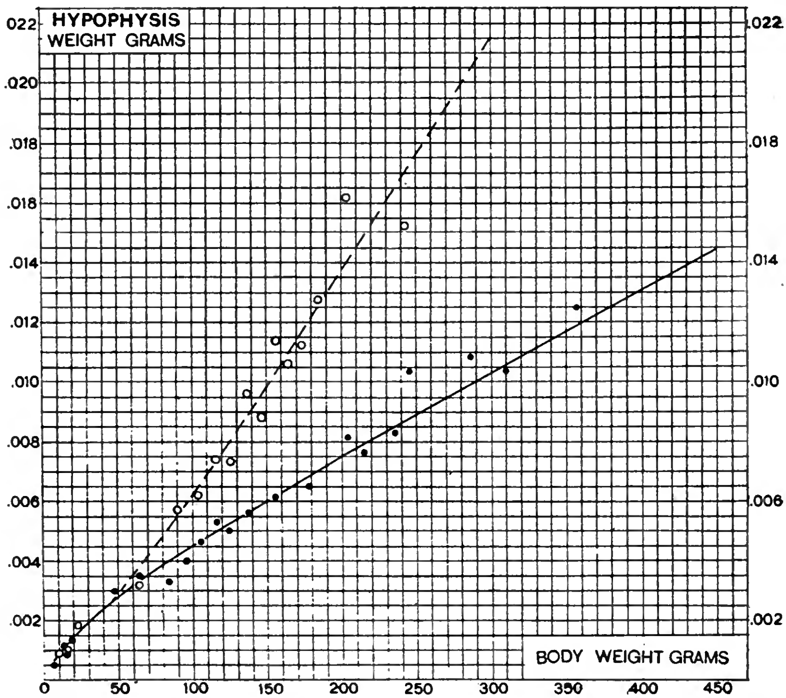

Chart 19 Showing the weight of hypophysis of the albino rat according to body weight. The observed weights are represented by 78 male and 80 female rats. Table 71, formulas (28) and (29).

● Observed weight, male. o Observed weight, female.
—— Calculated weight, male. - - - - Calculated weight, female.

of the suprarenals according to sex and with advancing age this difference tends to increase. The female has the heavier suprarenals. The graph for the male in chart 20 and the values for the male in table 71 have been determined by formula (30). The graph for the female and the corresponding tabular values, by formula (31). Hatai ('13); Jackson ('13).

6. *The third group of the organs here considered is formed by those the growth of which is represented by a sinuous graph in which the most marked rise appears shortly before puberty. These organs, so far as examined, are the ovaries, the testes and the thymus.*

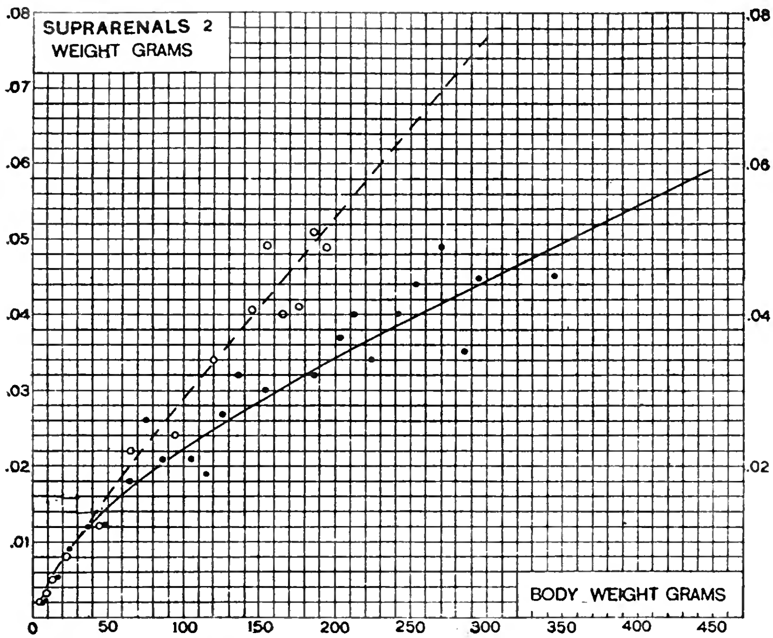

Chart 20 Showing the weight of suprarenals of the albino rat according to body weight. The observed weights are represented by 92 (Jackson) male rats below 50 grams in body weight, and 53 (Wistar) male rats above 50 grams in body weight; and 84 (Jackson) female rats below 50 grams in body weight, and 29 (Wistar) female rats above 50 grams in body weight. Table 71, formulas (30) and (31).

● Observed weight, male. ○ Observed weight, female.
—— Calculated weight, male. - - - - Calculated weight, female.

The weight of both ovaries on the body weight. Technic: The ovaries must be carefully dissected from their capsules and from the end of the fallopian tube. When the animal is small it is sometimes necessary to do this under a dissecting microscope. The data collected by Jackson ('13) are those used. The graph in chart 21 and the values in table 70 have been determined by formulas (25), (26), and (27). Hatai ('13, '14a); Jackson ('13).

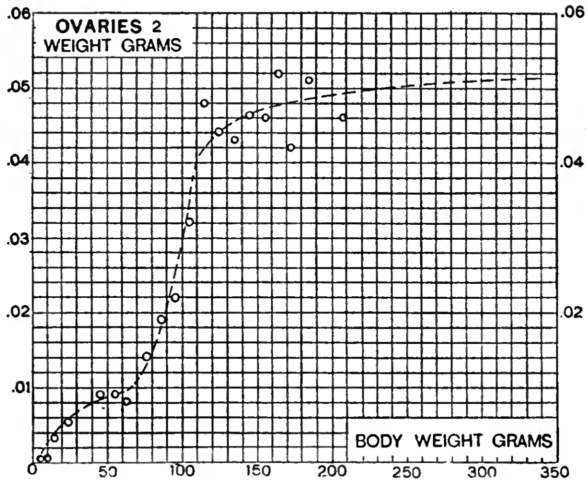

Chart 21 Showing the weight of ovaries of the female albino rat according to body weight. The observed weights are represented by 136 (Jackson) rats. Table 70, formulas (25), (26) and (27).

o Observed weight. ---- Calculated weight.

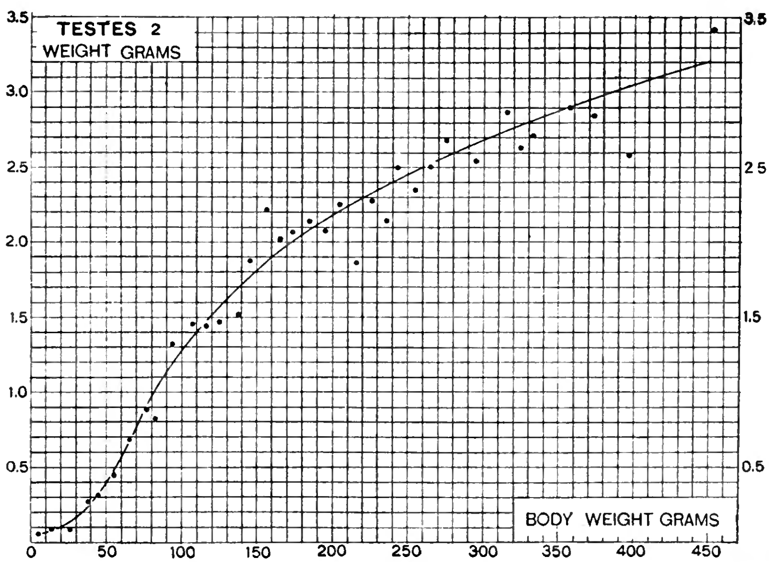

Chart 22 Showing the weight of testes of the male albino rat according to body weight. The observed weights are represented by 121 male rats. Table 70, formulas (22), (23) and (24).

● Observed weight. —— Calculated weight.

The weight of both testes on body weight. Technic: The epididymis was removed before the testes were weighed. The graph in chart 22 and the values in table 70 were determined by formulas (22), (23) and (24). Hatai ('13); Jackson ('13).

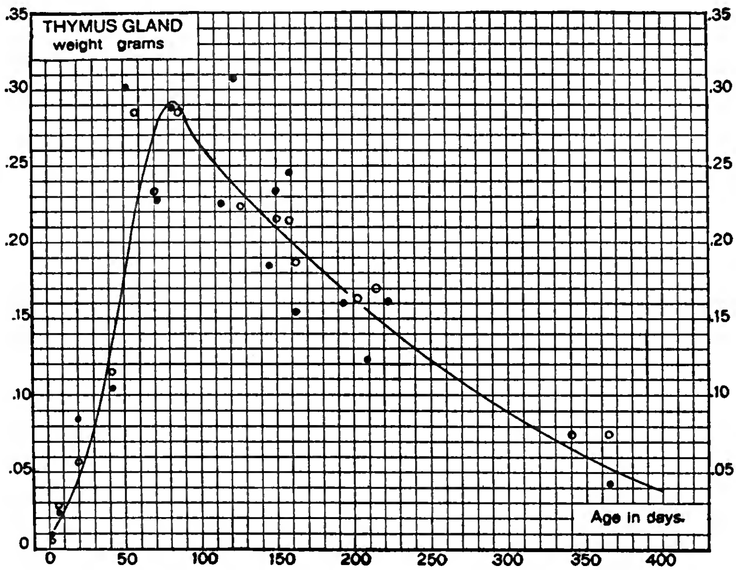

Chart 23 Showing the weight of the thymus of the albino rat according to age. The observed weights are represented by 229 males (164 Jackson and 64 Wistar) and 207 females (179 Jackson and 28 Wistar). Table 72, formulas (38) and (39). Observed weight ● male, ○ female, —— computed weight.

Weight of thymus on age. In the case of the thymus the data are more useful when presented according to age than when presented according to body weight.

Technic: In preparing the thymus care must be taken to dissect away the large lymph glands as well as the fat lying about it. The records by Jackson ('13) have been combined with those from The Wistar Institute. The graph in chart 23 and the values in table 72 have been determined by the formulas (38) and (39). No weight difference according to sex has been noted. Hatai ('14); Jackson ('13).

7. *Determinations of variation. Variation in body weight and organ weight.* In table 58 Jackson ('13) gives a series of determinations of the coefficient of variation for body weight on a litter basis and in age groups. The animals were selected by the method of 'random sampling.' These values are to be compared with those determined by King (MS '15). In King's series the same groups of rats were examined at different ages (table 67).

For the same animals as were used in table 58 Jackson ('13) also gives for the several organs the coefficient of variation (table 59) and the coefficients of correlation with the body weight (table 60). The coefficients of variation for body weight on age are given by King (MS '15) in her growth series (table 67).

TABLE 58.

Coefficient of variation in body weight for total population by ordinary method, and on litter basis (fraternal variation) estimated by various methods (Jackson, '13).

	SEX	NEWBORN	7 DAYS	20 DAYS	6 WEEKS	10 WEEKS	5 MONTHS
Total population (ordinary method)	Male	13.6[1]	16.9[1]	24.4[2]	20.8[2]	18.8[1]	18.5[1]
	Female	9.9[1]	13.7[1]	29.4[2]	24.2[2]	16.8[1]	15.3[1]
Litter basis (average of litters calculated by ordinary method)	Male	7.0	6.1	5.7	6.6	5.8	7.4
	Female	4.4	5.4	4.0	5.9	12.0	10.4
Litter basis (calculated from Yule's formula)	Male	6.8	7.6	6.8	7.1	6.1	8.1
	Female	5.2	4.4	4.5	7.9	12.2	9.3
Litter basis (from Kellogg's formula)	Male	7.3	8.4	6.0	7.2	6.7	8.5
	Female	5.2	4.5	4.1	8.5	12.0	9.0

[1] For net body weight.

[2] For gross body weight, larger series.

TABLE 59

Coefficients of variation in organ weights, albino rat at different ages. Arranged according to mean values in the last column (Jackson, '12).

	0 DAYS	7 DAYS	21 DAYS	42 DAYS	70 DAYS	150 DAYS	AVERAGE
Brain	12		7	12			10
Eyeballs	16	15	13	8	11	9	12
Head	10	11	15	10	14	13	12
Total body	12	16	28	21	20	19	19
Lungs	23	17	24	19	21		21
Kidneys	24	22	34	15	17	19	22
Heart	18	20	34	30	18	21	24
Liver	22	19	41	19	33	25	26
Suprarenals	24	20	33	22	21	39	26
Testes	25	18	30	27	35	41	29
Thymus	31	32	43	50	25	22	34
Spleen	39	34	51	26	38	19	34
Intestinal canal (plus contents)	38	29	42	30			35
Ovaries			42	47	51	33	43
Average of viscera	23	22	31	24	26	24	25

TABLE 60

Coefficients of correlation of organ weights with the body weight: albino rat at different ages. Arranged according to mean values in the last column (Jackson, '13).

	0 DAYS	7 DAYS	21 DAYS	42 DAYS	70 DAYS	150 DAYS	AVERAGE
Head	0.76	0.89	0.93	0.95	0.75	0.85	0.86
Kidneys	0.70	0.79	0.96	0.92	0.90	0.91	0.86
Liver	0.76	0.76	0.97	0.84	0.74	0.87	0.83
Lungs	0.74	0.80	0.87	0.94	0.62		0.80
Brain	0.69		0.78	0.88			0.78
Heart	0.58	0.50	0.91	0.97	0.86	0.84	0.78
Testes	0.67	0.75	0.95	0.75	0.48	0.88	0.75
Ovaries			0.73	0.64	0.82	0.81	0.75
Intestinal canal (plus contents)	0.29	0.59	0.84	0.76			0.62
Thymus	0.67	0.74	0.89	0.90	0.51	−0.09	0.60
Spleen	0.54	0.44	0.97	0.50	0.41	0.46	0.55
Eyeballs	0.67	0.52	0.67	0.31	0.22	0.32	0.45
Suprarenals	0.51	0.13	0.58	0.41	0.41	0.35	0.40
Average	0.63	0.63	0.85	0.75	0.62	0.70	0.70

8. *General Tables.* The tables which are not represented by charts in the text are usually short and have been introduced where they are mentioned, but as a matter of convenience all of those which are so represented are here grouped together as general tables under the following heads:

a). Tables for the increase in the weight of the entire body on age. Tables 61–67.

b). Tables for the increase in the length of the tail, in the weight of the entire body, and in the weight of several of the viscera according to body length. Tables 68–71 (72).

9. *Table 72 for the weight of the thymus—based not on body length but on age.*

10. *Weight of all the viscera combined.* Table 73.

11. *Tables giving the values for characters other than body weight, linked with age.* Table 74.

For the most part the tables are preceded by a slight descriptive heading only. Reference is made to the corresponding charts in connection with which all the details concerning them have been noted.

Tables showing the increase in the weight of the entire body with age.

Growth before birth, Stotsenburg (MS '15) (p. 64), table 61. This table duplicates table 46, but gives one additional entry.

TABLE 61

Showing the mean weights of the fetuses at ten ages during gestation and at birth. Stotsenburg (MS '15). Chart 1

AGE IN DAYS	NUMBER OF FETUSES	AVERAGE WEIGHT OF FETUS	RATE OF INCREASE IN WEIGHT
		grams	*per cent*
13	34	0.040	
14	44	0.112	179
15	37	0.168	50
16	44	0.310	83
17	21	0.548	77
18	43	1.000	83
19	30	1.580	58
20	25	2.630	65
21	42	3.980	51
22	10	4.630	16
Strictly new born	37	4.680	

Growth after birth, tables 62–67.

TABLE 62

Body weight on age—both sexes. Based on records by Donaldson, Dunn and Watson ('06) and computed from 10–365 days, by formulas (34), (35) males; (36), (37) females. The values for the first ten days are from direct observation, Donaldson (MS '15). Not charted

AGE DAYS	BODY WEIGHT		AGE DAYS	BODY WEIGHT		AGE DAYS	BODY WEIGHT		AGE DAYS	BODY WEIGHT	
	Male	Female		Male	Female		Male	Female		Male	Female
B.	4.8	4.7	33	32.8	34.4	66	94.5	89.4	99	164.3	145.1
1	5.5	5.4	34	34.1	35.7	67	97.0	91.5	100	165.8	146.2
2	5.9	5.8	35	35.4	37.0	68	99.5	93.6			
3	6.4	6.3	36	36.8	38.3	69	102.1	95.8	105	172.7	151.4
4	6.9	6.8	37	38.1	39.6	70	104.7	98.0	110	179.1	156.3
5	7.6	7.5	38	39.6	40.9				115	185.2	160.9
6	8.5	8.4	39	41.0	42.3	71	107.3	100.2	120	190.9	165.2
7	9.5	9.4	40	42.5	43.7	72	110.0	102.4	125	196.2	169.2
8	10.5	10.4				73	112.7	104.7	130	201.2	173.0
9	11.8	11.6	41	44.1	45.1	74	115.5	107.0	135	206.0	176.5
10	13.5	13.0	42	45.7	46.6	75	118.3	109.3	140	210.5	179.9
			43	47.3	48.1	76	121.1	111.6	145	214.7	183.1
11	13.9	13.7	44	48.9	49.6	77	124.0	114.0	150	218.7	186.1
12	14.4	14.4	45	50.6	51.1	78	126.8	116.4			
13	14.9	15.1	46	52.3	52.7	79	129.8	118.8	155	222.5	188.9
14	15.5	15.8	47	54.1	54.3	80	132.8	121.3	160	226.0	191.6
15	16.1	16.5	48	55.9	55.9				165	229.4	194.2
16	16.7	17.3	49	57.7	57.5	81	134.7	122.6	170	232.6	196.5
17	17.3	18.1	50	59.6	59.2	82	136.5	124.0	175	235.7	198.8
18	18.0	18.9				83	138.4	125.4	180	238.6	201.0
19	18.7	19.8	51	61.5	60.9	84	140.2	126.8	185	241.3	203.0
20	19.5	20.7	52	63.4	62.6	85	142.0	128.1	190	243.9	204.9
			53	65.4	64.3	86	143.7	129.5	195	246.3	206.7
21	20.3	21.6	54	67.4	66.1	87	145.5	130.8	200	248.6	208.4
22	21.1	22.5	55	69.5	67.9	88	147.2	132.1			
23	22.0	23.4	56	71.6	69.7	89	148.9	133.4	205	250.9	210.1
24	22.9	24.4	57	73.7	71.6	90	150.5	134.6	210	253.1	211.6
25	23.9	25.4	58	75.9	73.4				215	254.9	213.1
26	24.9	26.5	59	78.1	75.3	91	152.1	135.8	220	256.8	214.4
27	25.9	27.5	60	80.3	77.3	92	153.7	137.1	225	258.6	216.8
28	27.0	28.6				93	155.3	138.3	230	260.2	217.0
29	28.1	29.7	61	82.5	79.2	94	156.9	139.4	235	261.9	218.1
30	29.2	30.9	62	84.9	81.2	95	158.4	140.6	240	263.3	219.2
			63	87.2	83.2	96	160.0	141.8	245	264.8	220.3
31	30.4	32.0	64	89.6	85.2	97	161.4	142.9	250	266.1	221.2
32	31.6	33.2	65	92.0	87.3	98	162.9	144.0			

TABLE 62—Concluded

AGE DAYS	BODY WEIGHT		AGE DAYS	BODY WEIGHT		AGE DAYS	BODY WEIGHT		AGE DAYS	BODY WEIGHT	
	Male	Female		Male	Female		Male	Female		Male	Female
255	267.3	222.1	290	274.2	226.9	320	277.7	229.3	355	279.7	230.4
260	268.5	223.0	295	274.9	227.4	325	278.1	229.5	360	279.8	230.4
265	269.6	223.7	300	275.5	227.9	330	278.5	229.8	365	279.9	230.4
270	270.7	224.5				335	278.8	229.9			
275	271.6	225.1	305	276.2	228.3	340	279.1	230.1			
280	272.5	225.8	310	276.8	228.7	345	279.3	230.2			
285	273.4	226.4	315	277.2	229.0	350	279.6	230.3			

TABLE 63

Body weight on age. Male Albinos unmated. Chicago colony. Donaldson, Dunn and Watson, ('06). The records for the first ten days as given in the original table are here omitted. Those values may be obtained from table 62. In addition to the average values the highest and lowest are also given. See graph A in chart 2

AGE IN DAYS	BODY WEIGHT IN GRAMS			NUMBER OF ANIMALS
	Average	Lowest	Highest	
11	13.3	13.0	13.6	4
12	14.8	11.4	19.5	6
13	15.3	14.1	16.0	5
14	15.2	14.0	17.6	6
15	16.5	12.5	22.4	19
17	17.8	13.9	24.0	19
19	19.5	15.2	26.0	19
21	21.2	14.6	30.1	19
23	22.9	17.9	32.5	19
25	25.3	19.0	35.8	19
27	27.4	19.8	38.3	19
29	29.5	22.1	39.3	19
31	31.8	25.9	41.2	19
34	34.9	27.4	43.3	19
37	37.8	28.5	48.0	19
40	42.2	30.8	52.2	19
43	46.3	33.7	62.4	19
46	50.5	35.9	66.2	19
49	56.7	38.9	73.9	19
52	62.5	39.8	82.5	19
55	68.5	40.6	87.5	19
58	73.9	45.1	100.1	19
61	81.7	49.0	116.6	19
64	89.1	52.7	129.6	19
67	99.3	57.7	140.2	19
70	106.6	71.2	148.5	19
73	113.8	71.4	152.4	19
76	121.3	89.8	157.5	19
79	128.2	97.0	161.2	19
82	135.0	105.1	165.5	19
85	143.8	117.0	168.5	19
88	148.4	124.5	174.0	19
92	152.3	124.0	179.6	19
97	160.0	124.0	180.7	19
102	168.8	120.0	192.2	19
107	177.6	120.0	206.0	19
112	183.8	125.0	215.6	19

TABLE 63—Concluded

AGE IN DAYS	BODY WEIGHT IN GRAMS			NUMBER OF ANIMALS
	Average	Lowest	Highest	
117	191.4	130.0	223.0	19
124	197.3	123.0	238.2	19
131	202.5	132.4	249.2	19
138	209.7	145.6	248.4	19
143	218.3	155.5	259.4	19
150	225.4	162.4	268.2	19
157	227.0	162.4	271.4	19
164	231.4	159.0	271.8	17
171	235.8	165.2	289.0	17
178	239.4	167.9	291.2	17
185	239.8	176.0	294.0	15
216	252.9	190.5	294.5	10
256	265.4	190.5	310.0	10
365	279.0	203.6	320.0	6
730	308.5	285.0	375.6	6

TABLE 64

Body weight on age. Female albinos unmated. Values for 'mated' computed (Watson '05) Chicago colony. Donaldson, Dunn and Watson, ('06). The records for the first ten days as given in the original table are here omitted. Those values may be obtained from table 62. In addition to the average values the highest and lowest are also given. See graph A, in chart 3.

AGE IN DAYS	BODY WEIGHT IN GRAMS						NUMBER OF ANIMALS
	Average		Lowest		Highest		
11	12.8		12.1		13.6		2
12	15.1		13.6		17.7		5
13	15.1		14.7		16.0		5
14	15.6		13.5		18.1		5
15	17.7		13.1		23.2		17
17	19.2		15.1		24.5		17
19	20.6		16.9		27.0		17
21	22.6		16.1		30.1		17
23	24.9		17.3		33.3		17
25	27.4		20.8		36.0		17
27	30.0		23.9		38.5		17
29	31.4		24.0		39.0		17
31	32.9		26.3		42.8		17
34	35.7		26.4		44.1		17
37	39.5		29.8		47.4		17
40	43.7		30.6		52.4		17
43	47.9		35.0		60.7		17
46	52.0		41.4		63.0		16
49	57.7		42.0		69.2		16
52	62.9		41.7		74.8		16
55	68.4		49.8		80.7		13
58	74.6		53.6		86.6		13
61	78.4		56.2		96.7		13
64	85.8		57.5		106.8		12
67	96.0		71.2		114.1		12
70	99.8		79.0		122.6		11
73	105.6		80.2		126.5		11
76	110.4		89.6		131.6		11
79	118.8		97.7		136.0		11
82	124.7		101.0		139.2		11
85	131.5	*mated*	105.0	*mated*	143.2	*mated*	11
88	136.0		115.6		157.4		11
92	139.6	139.8	118.7	118.9	161.4	161.6	11
97	145.9	146.3	119.6	120.0	174.5	175.0	11
102	152.4	153.1	124.6	125.2	185.7	186.5	11
107	154.9	155.8	129.6	130.3	191.4	192.5	11
112	160.2	161.4	138.5	139.5	193.6	195.0	11

TABLE 64—Concluded

AGE IN DAYS	BODY WEIGHT IN GRAMS						NUMBER OF ANIMALS
	Average		Lowest		Highest		
117	166.5	168.0	142.5	143.8	199.0	200.8	11
124	170.7	172.6	146.4	148.0	206.7	209.0	11
131	178.6	181.0	151.2	153.0	214.7	217.5	11
138	182.2	185.0	151.0	153.3	210.2	213.4	11
143	183.4	186.6	154.0	156.7	219.4	223.4	11
150	184.6	188.2	153.7	156.7	220.7	225.0	11
157	184.0	188.0	154.9	158.2	217.6	222.4	11
164	185.1	189.5	154.0	157.6	215.0	220.1	11
171	187.4	192.2	154.0	158.0	210.0	215.4	11
178	191.7	197.0	153.0	157.2	215.0	221.0	11
185	194.2	200.0	152.0	156.6	215.0	221.4	11
192	195.9	202.2	155.0	160.0	217.0	224.0	11
365		226.4		171.4		280.0	7

TABLE 65

Increase in the body weight of the albino rat with age, based on a personal communication, Ferry ('13). New Haven Colony. See graphs B and B[1] Chart 2, and B, Chart 3

AGE IN DAYS	BODY WEIGHT		
	Males (1)		Females (3)
	grams		*grams*
10	14.6		13
20	22.3		25
30	35.3		38
40	51.7		54
50	73.1		73
60	96.8		89
70	113.6		100
80	127.7		105
90	143.7		115
100	157.3		120
110	168.3		125
120	180.8		133
130	190.4		137
140	197.4		146
150	208.3		150
160	211.9	*Males.*	152
170	218.3		158
180	225.7		160
190	233.5	(2)	164
200	243.1		168
210		254.0	169
220	253.3	262.0	172
230		264.0	172
240	268.2	270.0	172
250		272.0	170
260	259.1	276.0	171
270		280.0	173
280	265.2	287.0	176
300	267.4		

Column 1, males, includes some rats declining in body weight after 200 days.

Column 2, males, contains values from the normal growth curve (New Haven series).

Column 3, females, contains values read directly from normal growth curve, New Haven.

TABLE 66

Giving the number of animals used by Ferry, ('13) in computing her growth table 65, for the rats at the Connecticut Agricultural Experiment Station in New Haven. (Personal Communication).

In both groups the maximum number of observations was made at 30 days of age

MALES		FEMALES	
Age in days	Number of rats	Age in days	Number of rats
20–80	47–81	20–90	39–68
90–170	30–40	100–160	20–37
180–210	18–27	170–190	11–14
220–280	6–12	200–280	6–8

TABLE 67

Giving the increase in body weight with age—stock Albinos. Mean of two series—King (MS '15) and giving also the coefficients of variation with their probable errors. The Wistar Institute Colony. See graph C, Charts 2 and 3, and Chart 4.

	MALES			FEMALES		
Age in days	No. individuals	Average bd. wt.	Coefficient of variation	No. individuals	Average bd. wt.	Coefficient of variation
		grams			*grams*	
13	50	17.2	11.8±0.795	50	15.7	11.4±0.768
30	50	48.5	10.2±0.687	50	45.7	11.0±0.741
60	50	122.9	17.0±1.140	50	107.1	15.7±1.050
90	50	184.8	14.8±0.998	39	148.0	12.5±0.951
120	50	223.2	13.4±0.903	42	173.4	10.3±0.755
151	50	244.8	13.3±0.896	45	186.3	10.4±0.735
182	50	258.4	14.2±1.220	42	196.5	12.3±0.903
212	48	268.0	14.0±0.964	42	197.3	12.4±0.910
243	44	279.7	13.9±0.998	43	209.6	12.6±0.910
273	41	280.9	13.4±0.997	38	210.8	11.5±0.890
304	36	296.1	14.0±1.110	38	219.1	10.3±0.795
334	33	300.8	13.7±1.130	35	222.4	10.8±0.870
365	28	306.1	13.0±1.160	31	223.1	10.7±0.910
395	24	314.1	12.6±1.220	31	220.5	11.5±0.984
425	23	312.2	13.4±1.320	30	215.8	10.9±0.944
455	15	323.9	13.6±1.670	18	220.2	8.9±0.998
485	12	326.0	15.0±2.060	13	234.7	13.4±1.770

The four tables 68, 69, 70 and 71 which follow have been worked out on the basis of body length by the use of the appropriate formulas. The details touching the organs represented, as well as the corresponding graphs, are to be found in the earlier paragraphs of this chapter. The values for the body weights are repeated in each table.

Weights of viscera combined. Using the data in tables 68–71 (72) the total weight of the viscera—brain, spinal cord, both eyeballs, heart, both kidneys, liver, spleen, both lungs, alimentary tract, both testes, both ovaries, hypophysis, both suprarenals, thyroid and thymus (given separately)—has been entered after the total body weight at each millimeter of body length and for each sex. For obvious reasons the weight of the total blood (see table 70) has not been included.

For the thymus, the weight of which is most closely correlated with age, the following procedure has been employed. Using table 62 for the values for the body weights at given ages, the relation between age, body weight and thymus weight has been directly tabulated, and using these data as a basis, the values of the thymus for the body weight—which is assumed to be normal to the age—have been determined as given in table 73. Owing to the manner in which they have been obtained, it has seemed best to give the thymus values in a separate column.

The entries for the thymus cease after a body length of 221 mm. for males and 198 mm. for females, as these mark the limit of the data in table 62. But in animals of this size or larger, the value for the thymus has become very small both absolutely and relatively.

Tables giving characters which depend primarily on age.

Table 74 gives the percentage of water in the brain and in the spinal cord for each sex from birth to 365 days. These values have been computed by formulas (40), (41) and (42). The graphs corresponding to these data for the males are given in chart 26.

TABLE 68

Giving for each sex the tail length and the weights of the brain, spinal cord and both eyeballs for each millimeter of body length. See Charts 6, 7, 8, 9, 10

MALES						FEMALES				
Body length	Tail length	Body weight	Weight in gms.		Both eye-balls	Tail length	Body weight	Weight in gms.		Both eye-balls
			Brain	Spinal cord				Brain	Spinal cord	
mm.	*mm.*	*gms.*			*gms.*	*mm.*	*gms.*			*gms.*
47	14.9	4.9	0.226	0.033	0.029	15.4	4.7	0.211	0.033	0.028
48	15.8	4.9	0.226	0.033	0.029	16.6	4.7	0.214	0.033	0.028
49	16.9	5.0	0.232	0.034	0.030	17.8	4.9	0.217	0.034	0.029
50	18.0	5.1	0.238	0.034	0.031	19.0	5.0	0.222	0.035	0.029
51	19.2	5.2	0.252	0.035	0.031	20.2	5.1	0.227	0.035	0.030
52	20.4	5.3	0.266	0.036	0.032	21.5	5.3	0.255	0.036	0.032
53	21.6	5.4	0.280	0.037	0.033	22.7	5.5	0.283	0.038	0.034
54	22.7	5.6	0.300	0.038	0.034	23.9	5.8	0.323	0.041	0.036
55	23.9	5.8	0.320	0.040	0.036	25.2	6.2	0.361	0.044	0.039
56	25.0	6.1	0.358	0.043	0.039	26.4	6.5	0.398	0.048	0.041
57	26.2	6.4	0.395	0.046	0.041	27.6	6.9	0.433	0.051	0.044
58	27.3	6.8	0.431	0.049	0.044	28.8	7.2	0.468	0.054	0.046
59	28.5	7.1	0.465	0.052	0.046	30.0	7.6	0.500	0.057	0.049
60	29.6	7.5	0.498	0.055	0.048	31.2	8.0	0.532	0.061	0.051
61	30.7	7.9	0.530	0.059	0.050	32.3	8.4	0.564	0.064	0.053
62	31.9	8.2	0.561	0.062	0.052	33.5	8.7	0.594	0.068	0.055
63	33.0	8.6	0.591	0.065	0.054	34.7	9.1	0.624	0.071	0.057
64	34.1	9.0	0.621	0.068	0.056	35.9	9.5	0.652	0.074	0.059
65	35.2	9.4	0.650	0.071	0.058	37.0	9.9	0.679	0.077	0.061
66	36.3	9.8	0.678	0.075	0.060	38.2	10.3	0.703	0.081	0.063
67	37.4	10.1	0.695	0.078	0.062	39.4	10.8	0.726	0.084	0.065
68	38.5	10.6	0.711	0.081	0.064	40.5	11.2	0.772	0.088	0.067
69	39.6	11.0	0.761	0.084	0.066	41.7	11.6	0.811	0.091	0.068
70	40.7	11.4	0.803	0.088	0.068	42.8	12.0	0.846	0.095	0.070
71	41.8	11.8	0.840	0.091	0.069	43.9	12.5	0.876	0.098	0.072
72	42.9	12.2	0.872	0.094	0.071	45.1	12.9	0.904	0.101	0.073
73	44.0	12.7	0.901	0.098	0.073	46.2	13.4	0.929	0.105	0.075
74	45.1	13.1	0.928	0.101	0.074	47.3	13.9	0.952	0.108	0.077
75	46.2	13.6	0.952	0.104	0.076	48.5	14.3	0.974	0.112	0.078
76	47.2	14.0	0.974	0.107	0.077	49.6	14.8	0.994	0.115	0.080
77	48.3	14.5	0.995	0.111	0.079	50.7	15.3	1.013	0.119	0.082
78	49.4	15.0	1.015	0.114	0.081	51.8	15.8	1.031	0.122	0.083
79	50.4	15.4	1.033	0.117	0.082	52.9	16.3	1.047	0.126	0.085
80	51.5	15.9	1.051	0.121	0.084	54.0	16.8	1.064	0.129	0.086

TABLE 68—Continued

MALES						FEMALES				
Body length	Tail length	Body weight	Weight in gms.		Both eye-balls	Tail length	Body weight	Weight in gms.		Both eye-balls
			Brain	Spinal cord				Brain	Spinal cord	
mm.	*mm.*	*gms.*			*gms.*	*mm.*	*gms.*			*gms.*
81	52.6	16.4	1.067	0.124	0.085	55.1	17.3	1.079	0.133	0.088
82	53.6	16.9	1.083	0.128	0.087	56.3	17.9	1.093	0.136	0.089
83	54.7	17.4	1.098	0.131	0.088	57.4	18.4	1.107	0.140	0.091
84	55.7	18.0	1.112	0.134	0.090	58.5	19.0	1.121	0.143	0.093
85	56.8	18.5	1.126	0.138	0.091	59.5	19.5	1.134	0.147	0.094
86	57.8	19.0	1.139	0.141	0.093	60.6	20.1	1.146	0.150	0.095
87	58.9	19.6	1.152	0.144	0.094	61.7	20.7	1.159	0.154	0.097
88	59.9	20.1	1.165	0.148	0.095	62.8	21.2	1.170	0.158	0.098
89	61.0	20.7	1.177	0.151	0.097	63.9	21.8	1.181	0.161	0.100
90	62.0	21.3	1.188	0.155	0.098	65.0	22.4	1.193	0.165	0.101
91	63.0	21.9	1.200	0.158	0.100	66.1	23.1	1.203	0.168	0.103
92	64.1	22.4	1.211	0.162	0.101	67.2	23.7	1.214	0.172	0.104
93	65.1	23.0	1.221	0.165	0.102	68.2	24.3	1.224	0.176	0.105
94	66.2	23.7	1.231	0.168	0.104	69.3	25.0	1.234	0.179	0.107
95	67.2	24.3	1.242	0.172	0.105	70.4	25.6	1.244	0.183	0.108
96	68.2	24.9	1.252	0.175	0.107	71.4	26.3	1.253	0.186	0.109
97	69.2	25.6	1.261	0.179	0.108	72.5	27.0	1.262	0.190	0.111
98	70.3	26.2	1.271	0.182	0.109	73.6	27.7	1.271	0.194	0.112
99	71.3	26.9	1.280	0.186	0.111	74.6	28.4	1.280	0.197	0.114
100	72.3	27.5	1.289	0.189	0.112	75.7	29.1	1.289	0.201	0.115
101	73.3	28.2	1.298	0.193	0.113	76.8	29.8	1.298	0.205	0.116
102	74.3	28.9	1.307	0.197	0.115	77.8	30.5	1.306	0.209	0.118
103	75.4	29.6	1.315	0.200	0.116	78.9	31.3	1.314	0.212	0.119
104	76.4	30.3	1.323	0.204	0.117	79.9	32.0	1.322	0.216	0.120
105	77.4	31.1	1.332	0.207	0.119	81.0	32.8	1.330	0.220	0.122
106	78.4	31.8	1.340	0.211	0.120	82.0	33.6	1.338	0.223	0.123
107	79.4	32.5	1.348	0.214	0.121	83.1	34.4	1.346	0.227	0.124
108	80.4	33.3	1.356	0.218	0.123	84.1	35.2	1.354	0.231	0.126
109	81.4	34.1	1.363	0.221	0.124	85.2	36.0	1.361	0.235	0.127
110	82.4	34.9	1.371	0.225	0.125	86.2	36.9	1.368	0.238	0.128
111	83.4	35.7	1.378	0.228	0.126	87.3	37.7	1.376	0.242	0.130
112	84.4	36.5	1.386	0.232	0.128	88.3	38.6	1.383	0.246	0.131
113	85.4	37.3	1.393	0.236	0.129	89.4	39.5	1.390	0.250	0.132
114	86.4	38.2	1.400	0.239	0.130	90.4	40.3	1.397	0.253	0.134
115	87.4	39.0	1.407	0.243	0.132	91.4	41.3	1.404	0.257	0.135
116	88.4	39.9	1.414	0.246	0.133	92.5	42.2	1.411	0.261	0.136

TABLE 68—Continued

MALES						FEMALES				
Body length	Tail length	Body weight	Weight in gms.		Both eye-balls	Tail length	Body weight	Weight in gms.		Both eye-balls
			Brain	Spinal cord				Brain	Spinal cord	
mm.	mm.	gms.			gms.	mm.	gms.			gms.
117	89.4	40.8	1.421	0.250	0.134	93.5	43.1	1.418	0.265	0.138
118	90.4	41.6	1.428	0.254	0.136	94.5	44.1	1.424	0.268	0.139
119	91.4	42.6	1.435	0.257	0.137	95.6	45.0	1.431	0.272	0.140
120	92.4	43.5	1.442	0.261	0.138	96.6	46.0	1.438	0.276	0.142
121	93.4	44.4	1.448	0.265	0.140	97.6	47.0	1.444	0.280	0.143
122	94.4	45.4	1.455	0.268	0.141	98.7	48.0	1.450	0.284	0.144
123	95.4	46.3	1.461	0.272	0.142	99.7	49.1	1.457	0.287	0.146
124	96.4	47.3	1.468	0.276	0.143	100.7	50.1	1.463	0.291	0.147
125	97.4	48.3	1.474	0.279	0.145	101.7	51.2	1.469	0.295	0.148
126	98.4	49.3	1.480	0.283	0.146	102.8	52.3	1.476	0.299	0.150
127	99.3	50.4	1.487	0.287	0.147	103.8	53.4	1.482	0.303	0.151
128	100.3	51.4	1.493	0.290	0.149	104.8	54.5	1.488	0.307	0.153
129	101.3	52.5	1.499	0.294	0.150	105.8	55.6	1.494	0.310	0.154
130	102.3	53.6	1.505	0.297	0.151	106.8	56.8	1.500	0.314	0.155
131	103.3	54.7	1.511	0.301	0.153	107.9	58.0	1.506	0.318	0.157
132	104.2	55.8	1.517	0.305	0.154	108.9	59.2	1.512	0.322	0.158
133	105.2	56.9	1.523	0.309	0.155	109.9	60.4	1.518	0.326	0.159
134	106.2	58.1	1.529	0.312	0.157	110.9	61.6	1.523	0.330	0.161
135	107.2	59.3	1.535	0.316	0.158	111.9	62.9	1.529	0.334	0.162
136	108.2	60.5	1.541	0.320	0.160	112.9	64.2	1.535	0.338	0.164
137	109.1	61.7	1.546	0.323	0.161	114.0	65.5	1.540	0.341	0.165
138	110.1	62.9	1.552	0.327	0.162	115.0	66.8	1.546	0.345	0.166
139	111.1	64.1	1.558	0.331	0.164	116.0	68.1	1.552	0.349	0.168
140	112.1	65.4	1.563	0.335	0.165	117.0	69.5	1.557	0.353	0.169
141	113.0	66.7	1.569	0.338	0.166	118.0	70.9	1.563	0.357	0.171
142	114.0	68.0	1.575	0.342	0.168	119.0	72.3	1.568	0.361	0.172
143	115.0	69.3	1.580	0.346	0.169	120.0	73.7	1.574	0.365	0.174
144	115.9	70.7	1.586	0.349	0.171	121.0	75.2	1.579	0.369	0.175
145	116.9	72.1	1.591	0.353	0.172	122.0	76.7	1.585	0.373	0.177
146	117.9	73.5	1.597	0.357	0.173	123.0	78.2	1.590	0.377	0.178
147	118.8	74.9	1.602	0.361	0.175	124.0	79.7	1.595	0.380	0.180
148	119.8	76.3	1.607	0.365	0.176	125.0	81.3	1.601	0.384	0.181
149	120.8	77.8	1.613	0.368	0.178	126.0	82.8	1.606	0.388	0.182
150	121.7	79.3	1.618	0.372	0.179	127.0	84.4	1.611	0.392	0.184
151	122.7	80.8	1.623	0.376	0.181	128.0	86.1	1.616	0.396	0.186
152	123.7	82.4	1.629	0.380	0.182	129.0	87.7	1.622	0.400	0.187

TABLE 68—Continued

MALES						FEMALES				
Body length	Tail length	Body weight	Weight in gms.		Both eye-balls	Tail length	Body weight	Weight in gms.		Both eye-balls
			Brain	Spinal cord				Brain	Spinal cord	
mm.	*mm.*	*gms.*			*gms.*	*mm.*	*gms.*			*gms.*
153	124.6	83.9	1.634	0.383	0.183	130.0	89.4	1.627	0.404	0.189
154	125.6	85.5	1.639	0.387	0.185	131.0	91.1	1.632	0.408	0.190
155	126.5	87.1	1.644	0.391	0.186	132.0	92.9	1.637	0.412	0.192
156	127.5	88.7	1.649	0.395	0.188	133.0	94.6	1.642	0.416	0.193
157	128.5	90.4	1.654	0.398	0.189	134.0	96.4	1.647	0.420	0.195
158	129.4	92.1	1.659	0.402	0.191	135.0	98.3	1.652	0.424	0.196
159	130.4	93.8	1.664	0.406	0.192	136.0	100.1	1.657	0.428	0.198
160	131.3	95.6	1.670	0.410	0.194	137.0	102.0	1.662	0.432	0.200
161	132.3	97.3	1.675	0.414	0.196	137.9	103.9	1.667	0.436	0.201
162	133.3	99.2	1.680	0.417	0.197	138.9	105.9	1.672	0.440	0.203
163	134.2	101.0	1.685	0.421	0.199	139.9	107.9	1.677	0.444	0.204
164	135.2	102.8	1.690	0.425	0.200	140.9	109.9	1.682	0.448	0.206
165	136.1	104.7	1.695	0.429	0.202	141.9	111.9	1.687	0.452	0.208
166	137.1	106.7	1.699	0.433	0.203	142.9	114.0	1.692	0.456	0.209
167	138.0	108.6	1.704	0.436	0.205	143.9	116.1	1.697	0.460	0.211
168	139.0	110.6	1.709	0.440	0.207	144.9	118.3	1.702	0.464	0.213
169	139.9	112.6	1.714	0.444	0.208	145.9	120.5	1.707	0.468	0.215
170	140.9	114.8	1.719	0.448	0.210	146.8	122.7	1.711	0.472	0.216
171	141.8	116.7	1.724	0.452	0.212	147.8	125.0	1.716	0.476	0.218
172	142.8	118.9	1.729	0.456	0.213	148.8	127.3	1.721	0.480	0.220
173	143.7	121.0	1.734	0.459	0.215	149.8	129.6	1.726	0.484	0.222
174	144.7	123.2	1.738	0.463	0.217	150.8	132.0	1.731	0.488	0.223
175	145.6	125.4	1.743	0.467	0.218	151.8	134.4	1.735	0.492	0.225
176	146.6	127.7	1.748	0.471	0.220	152.7	136.8	1.740	0.496	0.227
177	147.5	130.0	1.753	0.475	0.222	153.7	139.3	1.745	0.500	0.229
178	148.5	132.3	1.757	0.479	0.224	154.7	141.9	1.750	0.504	0.231
179	149.4	134.6	1.762	0.483	0.225	155.7	144.4	1.754	0.508	0.232
180	150.4	137.0	1.767	0.486	0.227	156.7	147.1	1.759	0.512	0.234
181	151.3	139.5	1.771	0.490	0.229	157.6	149.7	1.764	0.516	0.236
182	152.3	142.0	1.776	0.494	0.231	158.6	152.4	1.768	0.520	0.238
183	153.2	144.5	1.781	0.498	0.233	159.6	155.2	1.773	0.524	0.240
184	154.1	147.0	1.785	0.502	0.234	160.6	158.0	1.778	0.528	0.242
185	155.1	149.6	1.790	0.506	0.236	161.5	160.8	1.782	0.532	0.244
186	156.0	152.3	1.795	0.510	0.238	162.5	163.7	1.787	0.536	0.246
187	157.0	155.0	1.799	0.513	0.240	163.5	166.6	1.791	0.540	0.248
188	157.9	157.7	1.804	0.517	0.242	164.5	169.6	1.796	0.544	0.250

TABLE 68—Continued

MALES						FEMALES				
Body length	Tail length	Body weight	Weight in gms.		Both eye-balls	Tail length	Body weight	Weight in gms.		Both eye-balls
			Brain	Spinal cord				Brain	Spinal cord	
mm.	mm.	gms.			gms.	mm.	gms.			gms.
189	158.9	160.5	1.808	0.521	0.244	165.4	172.6	1.801	0.548	0.252
190	159.8	163.3	1.813	0.525	0.246	166.4	175.7	1.805	0.552	0.254
191	160.7	166.2	1.818	0.529	0.248	167.4	178.8	1.810	0.556	0.256
192	161.7	169.1	1.822	0.533	0.250	168.4	182.0	1.814	0.560	0.258
193	162.6	172.0	1.827	0.537	0.252	169.3	185.2	1.819	0.564	0.261
194	163.6	175.0	1.831	0.541	0.254	170.3	188.5	1.823	0.569	0.263
195	164.5	178.1	1.836	0.545	0.256	171.3	191.9	1.828	0.573	0.265
196	165.4	181.2	1.840	0.548	0.258	172.2	195.3	1.832	0.577	0.267
197	166.4	184.3	1.845	0.552	0.260	173.2	198.7	1.837	0.581	0.269
198	167.3	187.5	1.849	0.556	0.262	174.2	202.2	1.841	0.585	0.272
199	168.3	190.8	1.854	0.560	0.264	175.1	205.8	1.846	0.589	0.274
200	169.2	194.1	1.858	0.564	0.266	176.1	209.4	1.850	0.593	0.276
201	170.1	197.4	1.863	0.568	0.268	177.1	213.1	1.855	0.597	0.278
202	171.1	200.8	1.867	0.572	0.271	178.0	216.8	1.859	0.601	0.281
203	172.0	204.3	1.872	0.576	0.273	179.0	220.7	1.864	0.605	0.283
204	172.9	207.8	1.876	0.579	0.275	180.0	224.5	1.868	0.609	0.286
205	173.9	211.4	1.880	0.583	0.277	180.9	228.4	1.872	0.613	0.288
206	174.8	215.0	1.885	0.587	0.280	181.9	232.4	1.877	0.617	0.290
207	175.7	218.7	1.889	0.591	0.282	182.9	236.5	1.881	0.621	0.293
208	176.7	222.5	1.894	0.595	0.284	183.8	240.6	1.886	0.625	0.295
209	177.6	226.3	1.898	0.599	0.288	184.8	244.8	1.890	0.630	0.298
210	178.5	230.2	1.903	0.603	0.289	185.8	249.1	1.894	0.634	0.301
211	179.5	234.1	1.907	0.607	0.291	186.7	253.4	1.899	0.638	0.303
212	180.4	238.1	1.911	0.611	0.294	187.7	257.8	1.903	0.642	0.306
213	181.3	242.2	1.916	0.615	0.296	188.7	262.3	1.908	0.646	0.308
214	182.3	246.3	1.920	0.619	0.299	189.6	266.9	1.912	0.650	0.311
215	183.2	250.5	1.924	0.623	0.301	190.6	271.5	1.916	0.654	0.314
216	184.1	254.7	1.929	0.626	0.304	191.5	276.2	1.921	0.658	0.317
217	185.0	259.1	1.933	0.630	0.306	192.5	281.0	1.925	0.662	0.319
218	186.0	263.5	1.937	0.634	0.309	193.5	285.8	1.929	0.666	0.322
219	186.9	267.9	1.942	0.638	0.312	194.4	290.8	1.934	0.670	0.325
220	187.8	272.5	1.946	0.642	0.314	195.4	295.8	1.938	0.675	0.328
221	188.8	277.1	1.950	0.646	0.317	196.3	300.9	1.942	0.679	0.331
222	189.7	281.8	1.955	0.650	0.320	197.3	306.1	1.947	0.683	0.334
223	190.6	286.5	1.959	0.654	0.322	198.3	311.3	1.951	0.687	0.337

TABLE 68—Concluded

MALES						FEMALES				
Body length	Tail length	Body weight	Weight in gms.		Both eye-balls	Tail length	Body weight	Weight in gms.		Both eye-balls
			Brain	Spinal cord				Brain	Spinal cord	
mm.	mm.	gms.			gms.	mm.	gms.			gms.
224	191.5	291.4	1.963	0.658	0.325	199.2	316.7	1.955	0.691	0.340
225	192.5	296.3	1.968	0.662	0.328	200.2	322.1	1.960	0.695	0.343
226	193.4	301.3	1.972	0.666	0.331	201.1	327.7	1.964	0.699	0.346
227	194.3	306.4	1.976	0.670	0.334	202.1	333.3	1.968	0.703	0.349
228	195.3	311.5	1.981	0.673	0.337	203.0	339.0	1.972	0.707	0.352
229	196.2	316.8	1.985	0.677	0.340	204.0	344.8	1.977	0.712	0.355
230	197.1	322.1	1.989	0.681	0.343	205.0	350.7	1.981	0.716	0.359
231	198.0	327.5	1.993	0.685	0.346	205.9	356.7	1.985	0.720	0.362
232	198.9	333.0	1.998	0.689	0.349	206.9	362.8	1.989	0.724	0.365
233	199.9	338.6	2.002	0.693	0.352	207.8	369.0	1.994	0.728	0.369
234	200.8	344.3	2.006	0.697	0.355	208.8	375.3	1.998	0.732	0.372
235	201.7	350.0	2.010	0.701	0.358	209.7	381.7	2.002	0.736	0.375
236	202.6	355.9	2.014	0.705	0.361	210.7	388.2	2.006	0.740	0.379
237	203.6	361.9	2.019	0.709	0.365	211.6	394.9	2.011	0.744	0.383
238	204.5	367.9	2.023	0.713	0.368	212.6	401.6	2.015	0.749	0.386
239	205.4	374.1	2.027	0.717	0.371	213.5	408.4	2.019	0.753	0.390
240	206.3	380.3	2.031	0.721	0.375	214.5	415.4	2.023	0.757	0.393
241	207.3	386.6	2.036	0.725	0.378	215.4	422.4	2.028	0.761	0.397
242	208.2	393.1	2.040	0.729	0.382	216.4	429.6	2.032	0.765	0.401
243	209.1	399.6	2.044	0.733	0.385	217.3	436.9	2.036	0.769	0.405
244	210.0	406.3	2.048	0.737	0.389	218.3	444.3	2.040	0.773	0.409
245	210.9	413.1	2.052	0.741	0.392	219.2	451.9	2.044	0.777	0.413
246	211.9	419.9	2.057	0.745	0.396	220.2	459.5	2.049	0.782	0.417
247	212.8	426.9	2.061	0.748	0.400	221.1	467.3	2.053	0.786	0.421
248	213.7	434.0	2.065	0.752	0.403	222.1	475.2	2.057	0.790	0.425
249	214.6	441.2	2.069	0.756	0.407	223.1	483.3	2.061	0.794	0.429
250	215.5	448.5	2.073	0.760	0.411	224.0	491.5	2.065	0.798	0.433

TABLE 69

Giving for each sex the weights of body, heart, both kidneys, liver and spleen—for each millimeter of body length. See Charts 11, 12, 13 and 14

	MALES					FEMALES				
Body length	Body weight	Heart	Both kidneys	Liver	Spleen	Body weight	Heart	Both kidneys	Liver	Spleen
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
47	4.9	0.031	0.046	0.21	0.009	4.7	0.030	0.046	0.20	0.008
48	4.9	0.031	0.047	0.21	0.009	4.7	0.030	0.046	0.20	0.008
49	5.0	0.032	0.048	0.22	0.009	4.9	0.032	0.048	0.21	0.009
50	5.1	0.033	0.049	0.22	0.009	5.0	0.033	0.050	0.22	0.009
51	5.2	0.033	0.052	0.22	0.010	5.1	0.034	0.052	0.23	0.009
52	5.3	0.034	0.055	0.23	0.010	5.3	0.035	0.055	0.23	0.009
53	5.4	0.035	0.058	0.23	0.010	5.5	0.036	0.062	0.24	0.011
54	5.6	0.036	0.064	0.24	0.011	5.8	0.038	0.070	0.25	0.012
55	5.8	0.038	0.070	0.25	0.012	6.2	0.042	0.081	0.27	0.014
56	6.1	0.041	0.078	0.26	0.014	6.5	0.044	0.088	0.28	0.015
57	6.4	0.043	0.086	0.28	0.015	6.9	0.047	0.097	0.30	0.017
58	6.8	0.046	0.095	0.29	0.017	7.2	0.049	0.103	0.32	0.018
59	7.1	0.049	0.101	0.31	0.018	7.6	0.052	0.112	0.34	0.020
60	7.5	0.052	0.110	0.33	0.020	8.0	0.056	0.119	0.36	0.022
61	7.9	0.055	0.117	0.35	0.021	8.4	0.058	0.127	0.38	0.023
62	8.2	0.057	0.123	0.37	0.023	8.7	0.061	0.132	0.40	0.025
63	8.6	0.060	0.130	0.40	0.024	9.1	0.064	0.139	0.43	0.026
64	9.0	0.063	0.137	0.42	0.026	9.5	0.067	0.145	0.45	0.028
65	9.4	0.066	0.143	0.45	0.027	9.9	0.069	0.151	0.48	0.029
66	9.8	0.069	0.150	0.48	0.029	10.3	0.072	0.157	0.52	0.031
67	10.1	0.071	0.154	0.50	0.030	10.8	0.076	0.165	0.59	0.033
68	10.6	0.074	0.162	0.56	0.032	11.2	0.079	0.171	0.63	0.034
69	11.0	0.077	0.168	0.61	0.033	11.6	0.081	0.176	0.68	0.036
70	11.4	0.080	0.173	0.66	0.035	12.0	0.084	0.182	0.73	0.037
71	11.8	0.083	0.179	0.71	0.036	12.5	0.087	0.188	0.79	0.039
72	12.2	0.085	0.184	0.75	0.038	12.9	0.090	0.194	0.83	0.040
73	12.7	0.089	0.191	0.81	0.039	13.4	0.093	0.200	0.89	0.042
74	13.1	0.091	0.194	0.85	0.041	13.9	0.097	0.206	0.94	0.044
75	13.6	0.095	0.203	0.91	0.042	14.3	0.099	0.211	0.98	0.045
76	14.0	0.097	0.207	0.95	0.044	14.8	0.102	0.217	1.03	0.047
77	14.5	0.100	0.214	1.00	0.046	15.3	0.105	0.223	1.09	0.048
78	15.0	0.104	0.220	1.06	0.047	15.8	0.109	0.229	1.14	0.050
79	15.4	0.106	0.224	1.10	0.049	16.3	0.112	0.235	1.19	0.051
80	15.9	0.109	0.230	1.15	0.050	16.8	0.115	0.241	1.24	0.053

TABLE 69—Continued

	MALES					FEMALES				
Body length	Body weight	Heart	Both kidneys	Liver	Spleen	Body weight	Heart	Both kidneys	Liver	Spleen
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
81	16.4	0.112	0.236	1.20	0.052	17.3	0.118	0.246	1.28	0.055
82	16.9	0.115	0.242	1.24	0.053	17.9	0.121	0.253	1.34	0.057
83	17.4	0.118	0.247	1.29	0.055	18.4	0.124	0.258	1.39	0.058
84	18.0	0.122	0.254	1.35	0.057	19.0	0.128	0.265	1.44	0.060
85	18.5	0.125	0.259	1.40	0.059	19.5	0.131	0.270	1.49	0.062
86	19.0	0.128	0.265	1.44	0.060	20.1	0.134	0.277	1.54	0.064
87	19.6	0.131	0.271	1.50	0.062	20.7	0.138	0.283	1.59	0.065
88	20.1	0.134	0.277	1.54	0.064	21.2	0.141	0.288	1.64	0.067
89	20.7	0.138	0.283	1.59	0.065	21.8	0.144	0.294	1.69	0.069
90	21.3	0.141	0.289	1.64	0.067	22.4	0.147	0.300	1.74	0.071
91	21.9	0.145	0.296	1.69	0.069	23.1	0.151	0.307	1.79	0.073
92	22.4	0.147	0.300	1.74	0.071	23.7	0.155	0.313	1.84	0.075
93	23.0	0.151	0.306	1.79	0.072	24.3	0.158	0.319	1.89	0.076
94	23.7	0.155	0.313	1.84	0.075	25.0	0.162	0.326	1.95	0.078
95	24.3	0.158	0.319	1.89	0.076	25.6	0.165	0.332	1.99	0.080
96	24.9	0.161	0.325	1.94	0.078	26.3	0.169	0.339	2.05	0.082
97	25.6	0.165	0.332	1.99	0.080	27.0	0.172	0.344	2.10	0.084
98	26.2	0.168	0.338	2.05	0.082	27.7	0.176	0.352	2.15	0.086
99	26.9	0.172	0.345	2.09	0.084	28.4	0.180	0.359	2.21	0.088
100	27.5	0.175	0.350	2.14	0.086	29.1	0.183	0.365	2.26	0.090
101	28.2	0.178	0.357	2.19	0.088	29.8	0.187	0.372	2.31	0.092
102	28.9	0.182	0.364	2.24	0.090	30.5	0.190	0.378	2.36	0.094
103	29.6	0.186	0.370	2.29	0.092	31.3	0.194	0.386	2.41	0.097
104	30.3	0.189	0.377	2.34	0.094	32.0	0.198	0.392	2.46	0.099
105	31.1	0.193	0.384	2.40	0.096	32.8	0.202	0.400	2.52	0.101
106	31.8	0.197	0.390	2.45	0.098	33.6	0.206	0.407	2.57	0.103
107	32.5	0.200	0.397	2.50	0.100	34.4	0.209	0.414	2.63	0.106
108	33.3	0.204	0.404	2.55	0.102	35.2	0.213	0.421	2.68	0.108
109	34.1	0.208	0.411	2.61	0.105	36.0	0.217	0.428	2.73	0.110
110	34.9	0.212	0.419	2.66	0.107	36.9	0.221	0.436	2.79	0.113
111	35.7	0.216	0.426	2.71	0.109	37.7	0.225	0.444	2.84	0.115
112	36.5	0.219	0.433	2.77	0.112	38.6	0.229	0.451	2.90	0.117
113	37.3	0.223	0.440	2.82	0.114	39.5	0.234	0.459	2.96	0.120
114	38.2	0.227	0.448	2.88	0.116	40.3	0.237	0.466	3.01	0.122
115	39.0	0.231	0.455	2.93	0.118	41.3	0.242	0.475	3.07	0.125
116	39.9	0.235	0.463	2.98	0.121	42.2	0.246	0.483	3.13	0.127
117	40.8	0.239	0.471	3.04	0.123	43.1	0.250	0.491	3.18	0.130

TABLE 69—Continued

	MALES					FEMALES				
Body length	Body weight	Heart	Both kidneys	Liver	Spleen	Body weight	Heart	Both kidneys	Liver	Spleen
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
118	41.6	0.243	0.478	3.09	0.126	44.1	0.254	0.499	3.24	0.133
119	42.6	0.248	0.486	3.15	0.128	45.0	0.258	0.507	3.29	0.135
120	43.5	0.252	0.494	3.20	0.131	46.0	0.263	0.515	3.35	0.138
121	44.4	0.256	0.502	3.26	0.133	47.0	0.267	0.524	3.41	0.141
122	45.4	0.260	0.510	3.32	0.136	48.0	0.272	0.532	3.47	0.143
123	46.3	0.264	0.518	3.37	0.139	49.1	0.276	0.542	3.53	0.146
124	47.3	0.269	0.526	3.43	0.141	50.1	0.281	0.550	3.59	0.149
125	48.3	0.273	0.535	3.49	0.144	51.2	0.285	0.559	3.65	0.152
126	49.3	0.277	0.543	3.54	0.147	52.3	0.290	0.568	3.71	0.155
127	50.4	0.282	0.553	3.61	0.150	53.4	0.295	0.578	3.77	0.158
128	51.4	0.286	0.561	3.66	0.152	54.5	0.299	0.587	3.83	0.161
129	52.5	0.291	0.570	3.72	0.155	55.6	0.304	0.596	3.89	0.164
130	53.6	0.295	0.579	3.78	0.158	56.8	0.309	0.606	3.96	0.167
131	54.7	0.300	0.588	3.84	0.161	58.0	0.314	0.616	4.02	0.170
132	55.8	0.305	0.598	3.90	0.164	59.2	0.319	0.626	4.09	0.173
133	56.9	0.309	0.607	3.96	0.167	60.4	0.324	0.635	4.15	0.177
134	58.1	0.314	0.617	4.03	0.171	61.6	0.328	0.645	4.21	0.180
135	59.3	0.319	0.626	4.09	0.174	62.9	0.334	0.656	4.28	0.183
136	60.5	0.324	0.636	4.15	0.177	64.2	0.339	0.666	4.35	0.187
137	61.7	0.329	0.646	4.22	0.180	65.5	0.344	0.677	4.41	0.190
138	62.9	0.334	0.656	4.28	0.183	66.8	0.349	0.687	4.48	0.194
139	64.1	0.338	0.666	4.34	0.186	68.1	0.354	0.698	4.54	0.197
140	65.4	0.344	0.676	4.41	0.190	69.5	0.360	0.709	4.61	0.201
141	66.7	0.349	0.687	4.47	0.193	70.9	0.365	0.720	4.68	0.204
142	68.0	0.354	0.697	4.54	0.197	72.3	0.370	0.732	4.75	0.208
143	69.3	0.359	0.708	4.60	0.200	73.7	0.376	0.743	4.82	0.212
144	70.7	0.364	0.719	4.67	0.204	75.2	0.382	0.755	4.89	0.216
145	72.1	0.370	0.730	4.74	0.208	76.7	0.387	0.767	4.97	0.220
146	73.5	0.375	0.741	4.81	0.211	78.2	0.393	0.779	5.04	0.224
147	74.9	0.380	0.752	4.88	0.215	79.7	0.399	0.791	5.11	0.228
148	76.3	0.386	0.764	4.95	0.219	81.3	0.405	0.803	5.19	0.232
149	77.8	0.391	0.775	5.02	0.223	82.8	0.410	0.815	5.26	0.236
150	79.3	0.397	0.787	5.09	0.227	84.4	0.416	0.828	5.33	0.240
151	80.8	0.403	0.799	5.16	0.230	86.1	0.422	0.841	5.41	0.244
152	82.4	0.409	0.812	5.24	0.235	87.7	0.428	0.854	5.48	0.248
153	83.9	0.414	0.824	5.31	0.239	89.4	0.435	0.867	5.56	0.253

TABLE 69—Continued

MALES						FEMALES				
Body length	Body weight	Heart	Both kidneys	Liver	Spleen	Body weight	Heart	Both kidneys	Liver	Spleen
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
154	85.5	0.420	0.836	5.38	0.243	91.1	0.441	0.880	5.64	0.257
155	87.1	0.426	0.849	5.46	0.247	92.9	0.447	0.894	5.72	0.262
156	88.7	0.432	0.862	5.53	0.251	94.6	0.453	0.908	5.80	0.266
157	90.4	0.438	0.875	5.61	0.255	96.4	0.460	0.922	5.88	0.271
158	92.1	0.444	0.888	5.68	0.260	98.3	0.467	0.937	5.96	0.276
159	93.8	0.450	0.901	5.76	0.264	100.1	0.473	0.951	6.04	0.281
160	95.6	0.457	0.916	5.84	0.269	102.0	0.480	0.965	6.12	0.285
161	97.3	0.463	0.929	5.92	0.273	103.9	0.486	0.980	6.21	0.290
162	99.2	0.470	0.944	6.00	0.278	105.9	0.493	0.996	6.29	0.295
163	101.0	0.476	0.958	6.08	0.283	107.9	0.500	1.011	6.38	0.301
164	102.8	0.483	0.971	6.16	0.287	109.9	0.507	1.026	6.47	0.306
165	104.7	0.489	0.986	6.24	0.292	111.9	0.514	1.042	6.55	0.311
166	106.7	0.496	1.002	6.33	0.298	114.0	0.522	1.058	6.64	0.316
167	108.6	0.502	1.016	6.41	0.302	116.1	0.529	1.074	6.73	0.322
168	110.6	0.510	1.032	6.50	0.308	118.3	0.536	1.091	6.82	0.327
169	112.6	0.517	1.047	6.58	0.313	120.5	0.544	1.108	6.92	0.333
170	114.7	0.524	1.063	6.67	0.318	122.7	0.551	1.125	7.01	0.339
171	116.7	0.531	1.079	6.76	0.323	125.0	0.559	1.142	7.10	0.344
172	118.9	0.538	1.096	6.85	0.329	127.3	0.567	1.160	7.20	0.350
173	121.0	0.545	1.112	6.94	0.334	129.6	0.575	1.178	7.29	0.356
174	123.2	0.553	1.129	7.03	0.340	132.0	0.583	1.196	7.39	0.362
175	125.4	0.560	1.145	7.12	0.345	134.4	0.591	1.214	7.49	0.368
176	127.7	0.568	1.163	7.22	0.351	136.8	0.599	1.232	7.59	0.375
177	130.0	0.576	1.181	7.31	0.357	139.3	0.607	1.251	7.69	0.381
178	132.3	0.584	1.198	7.40	0.363	141.9	0.615	1.271	7.79	0.387
179	134.6	0.591	1.216	7.50	0.369	144.4	0.624	1.290	7.89	0.394
180	137.0	0.599	1.234	7.60	0.375	147.1	0.632	1.311	8.00	0.401
181	139.5	0.607	1.253	7.70	0.381	149.7	0.641	1.330	8.10	0.407
182	142.0	0.616	1.272	7.80	0.388	152.4	0.650	1.351	8.21	0.414
183	144.5	0.622	1.291	7.90	0.394	155.2	0.659	1.372	8.32	0.421
184	147.0	0.632	1.310	8.00	0.400	158.0	0.668	1.393	8.43	0.428
185	149.6	0.641	1.330	8.10	0.407	160.8	0.677	1.414	8.54	0.435
186	152.3	0.649	1.350	8.21	0.414	163.7	0.686	1.436	8.65	0.443
187	155.0	0.658	1.370	8.31	0.421	166.6	0.696	1.458	8.77	0.450
188	157.7	0.667	1.391	8.42	0.428	169.6	0.705	1.481	8.88	0.458
189	160.5	0.676	1.412	8.53	0.435	172.6	0.715	1.503	9.00	0.465
190	163.3	0.685	1.433	8.64	0.442	175.7	0.725	1.526	9.12	0.473

TABLE 69—Continued

	MALES					FEMALES				
Body length	Body weight	Heart	Both kidneys	Liver	Spleen	Body weight	Heart	Both kidneys	Liver	Spleen
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
191	166.2	0.694	1.455	8.75	0.449	178.8	0.734	1.550	9.23	0.481
192	169.1	0.704	1.477	8.86	0.456	182.0	0.744	1.574	9.36	0.489
193	172.0	0.713	1.499	8.98	0.464	185.2	0.755	1.598	9.48	0.497
194	175.0	0.722	1.521	9.09	0.471	188.5	0.765	1.622	9.60	0.505
195	178.1	0.732	1.544	9.21	0.479	191.9	0.776	1.648	9.73	0.514
196	181.2	0.742	1.568	9.33	0.487	195.3	0.786	1.673	9.86	0.522
197	184.3	0.752	1.591	9.45	0.495	198.7	0.797	1.699	9.99	0.531
198	187.5	0.762	1.615	9.57	0.503	202.2	0.808	1.725	10.12	0.540
199	190.8	0.772	1.640	9.69	0.511	205.8	0.819	1.752	10.25	0.549
200	194.1	0.782	1.664	9.82	0.519	209.4	0.830	1.779	10.39	0.558
201	197.4	0.793	1.689	9.94	0.528	213.1	0.841	1.806	10.52	0.567
202	200.8	0.803	1.714	10.07	0.536	216.8	0.853	1.834	10.66	0.577
203	204.3	0.814	1.740	10.20	0.545	220.7	0.865	1.863	10.80	0.586
204	207.8	0.825	1.767	10.33	0.554	224.5	0.876	1.891	10.94	0.596
205	211.4	0.836	1.793	10.46	0.563	228.4	0.888	1.920	11.09	0.606
206	215.0	0.847	1.820	10.59	0.572	232.4	0.900	1.950	11.23	0.616
207	218.7	0.859	1.848	10.73	0.581	236.5	0.913	1.980	11.38	0.626
208	222.5	0.870	1.876	10.87	0.591	240.6	0.925	2.011	11.53	0.636
209	226.3	0.882	1.904	11.01	0.600	244.8	0.938	2.042	11.68	0.647
210	230.2	0.894	1.933	11.15	0.610	249.1	0.951	2.074	11.84	0.657
211	234.1	0.905	1.962	11.29	0.620	253.4	0.964	2.106	11.99	0.668
212	238.1	0.918	1.992	11.44	0.630	257.8	0.977	2.138	12.15	0.679
213	242.2	0.930	2.023	11.59	0.640	262.3	0.990	2.171	12.31	0.691
214	246.3	0.942	2.053	11.74	0.650	266.9	1.004	2.205	12.47	0.702
215	250.5	0.955	2.084	11.89	0.661	271.5	1.018	2.239	12.64	0.713
216	254.7	0.968	2.115	12.04	0.671	276.2	1.032	2.274	12.80	0.725
217	259.1	0.981	2.148	12.20	0.683	281.0	1.046	2.310	12.97	0.737
218	263.5	0.994	2.180	12.35	0.694	285.8	1.060	2.345	13.14	0.749
219	267.9	1.007	2.213	12.50	0.704	290.8	1.075	2.382	13.32	0.762
220	272.5	1.021	2.247	12.67	0.716	295.8	1.090	2.419	13.50	0.774
221	277.1	1.034	2.281	12.84	0.727	300.9	1.105	2.457	13.67	0.787
222	281.8	1.048	2.316	13.00	0.739	306.1	1.120	2.495	13.86	0.800
223	286.5	1.062	2.350	13.17	0.751	311.3	1.135	2.533	14.04	0.813
224	291.4	1.077	2.386	13.34	0.763	316.7	1.151	2.573	14.23	0.826
225	296.3	1.091	2.423	13.51	0.775	322.1	1.167	2.613	14.41	0.840
226	301.3	1.106	2.460	13.69	0.788	327.7	1.183	2.654	14.61	0.854
227	306.4	1.121	2.497	13.87	0.801	333.3	1.200	2.695	14.80	0.868

TABLE 69—Concluded

	MALES					FEMALES				
Body length	Body weight	Heart	Both kidneys	Liver	Spleen	Body weight	Heart	Both kidneys	Liver	Spleen
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
228	311.5	1.136	2.535	14.05	0.813	339.0	1.216	2.737	15.00	0.882
229	316.8	1.152	2.574	14.23	0.826	344.8	1.233	2.780	15.20	0.896
230	322.1	1.167	2.613	14.41	0.840	350.7	1.250	2.823	15.40	0.911
231	327.5	1.183	2.652	14.60	0.853	356.7	1.268	2.867	15.61	0.926
232	333.0	1.199	2.693	14.79	0.867	362.8	1.285	2.912	15.82	0.941
233	338.6	1.215	2.734	14.99	0.881	369.0	1.303	2.957	16.03	0.956
234	344.3	1.232	2.776	15.18	0.895	375.3	1.321	3.004	16.24	0.972
235	350.0	1.248	2.818	15.38	0.909	381.7	1.340	3.050	16.46	0.988
236	355.9	1.265	2.861	15.58	0.924	388.2	1.358	3.098	16.68	1.004
237	361.9	1.283	2.905	15.79	0.939	394.9	1.377	3.147	16.91	1.021
238	367.9	1.300	2.949	15.99	0.954	401.6	1.397	3.196	17.14	1.037
239	374.1	1.318	2.995	16.20	0.969	408.4	1.416	3.246	17.37	1.054
240	380.3	1.336	3.040	16.42	0.984	415.4	1.436	3.297	17.61	1.072
241	386.6	1.354	3.086	16.63	1.000	422.4	1.456	3.349	17.84	1.089
242	393.1	1.372	3.134	16.85	1.016	429.6	1.477	3.401	18.08	1.107
243	399.6	1.391	3.182	17.07	1.032	436.9	1.497	3.455	18.33	1.125
244	406.3	1.410	3.231	17.30	1.049	444.3	1.518	3.509	18.58	1.143
245	413.1	1.429	3.280	17.53	1.066	451.9	1.540	3.564	18.83	1.162
246	419.9	1.449	3.330	17.76	1.083	459.5	1.561	3.620	19.09	1.181
247	426.9	1.469	3.381	17.98	1.100	467.3	1.583	3.677	19.35	1.200
248	434.0	1.489	3.433	18.23	1.118	475.2	1.606	3.734	19.61	1.220
249	441.2	1.509	3.486	18.47	1.136	483.3	1.628	3.794	19.88	1.240
250	448.5	1.530	3.539	18.72	1.154	491.5	1.652	3.853	20.15	1.260

TABLE 70

Giving for each sex the weights of body, lungs, blood, alimentary tract and gonads (testes and ovaries) for each millimeter of body length. See Charts 15, 16, 17, 21 and 22.

MALES						FEMALES				
Body length	Body weight	Lungs	Blood	Alimen. tract	Testes	Body weight	Lungs	Blood	Alimen. tract	Ovaries
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
47	4.9	0.078	0.44	0.14	0.004	4.7	0.078	0.41	0.14	0.0006
48	4.9	0.079	0.44	0.14	0.004	4.7	0.079	0.41	0.14	0.0006
49	5.0	0.080	0.45	0.15	0.004	4.9	0.080	0.43	0.15	0.0008
50	5.1	0.081	0.45	0.15	0.004	5.0	0.081	0.44	0.15	0.0009
51	5.2	0.082	0.46	0.15	0.004	5.1	0.082	0.45	0.15	0.0009
52	5.3	0.083	0.47	0.16	0.006	5.3	0.084	0.47	0.16	0.0010
53	5.4	0.085	0.48	0.16	0.006	5.5	0.086	0.49	0.16	0.0011
54	5.6	0.087	0.50	0.17	0.007	5.8	0.090	0.51	0.18	0.0013
55	5.8	0.090	0.51	0.18	0.007	6.2	0.094	0.54	0.19	0.0015
56	6.1	0.093	0.53	0.19	0.009	6.5	0.097	0.56	0.20	0.0016
57	6.4	0.096	0.56	0.20	0.011	6.9	0.102	0.60	0.22	0.0019
58	6.8	0.101	0.59	0.21	0.013	7.2	0.105	0.62	0.23	0.0020
59	7.1	0.104	0.61	0.22	0.016	7.6	0.109	0.65	0.24	0.0022
60	7.5	0.108	0.64	0.24	0.019	8.0	0.113	0.68	0.25	0.0024
61	7.9	0.112	0.67	0.25	0.023	8.4	0.117	0.71	0.27	0.0025
62	8.2	0.115	0.69	0.26	0.026	8.7	0.120	0.73	0.27	0.0026
63	8.6	0.119	0.73	0.27	0.031	9.1	0.124	0.76	0.28	0.0028
64	9.0	0.123	0.76	0.28	0.036	9.5	0.128	0.79	0.30	0.0029
65	9.4	0.127	0.79	0.29	0.041	9.9	0.131	0.82	0.31	0.0031
66	9.8	0.130	0.82	0.30	0.047	10.3	0.135	0.85	0.34	0.0032
67	10.1	0.133	0.84	0.31	0.050	10.8	0.139	0.89	0.41	0.0034
68	10.6	0.138	0.88	0.39	0.051	11.2	0.143	0.92	0.47	0.0035
69	11.0	0.141	0.91	0.44	0.052	11.6	0.146	0.95	0.52	0.0036
70	11.4	0.145	0.93	0.50	0.053	12.0	0.150	0.98	0.58	0.0037
71	11.8	0.148	0.96	0.55	0.054	12.5	0.154	1.02	0.64	0.0039
72	12.2	0.152	0.99	0.60	0.055	12.9	0.157	1.04	0.69	0.0040
73	12.7	0.155	1.03	0.67	0.057	13.4	0.161	1.08	0.76	0.0041
74	13.1	0.159	1.06	0.72	0.058	13.9	0.165	1.12	0.82	0.0042
75	13.6	0.163	1.10	0.78	0.060	14.3	0.169	1.13	0.87	0.0043
76	14.0	0.166	1.12	0.83	0.061	14.8	0.173	1.18	0.93	0.0044
77	14.5	0.170	1.16	0.89	0.063	15.3	0.177	1.22	0.99	0.0046
78	15.0	0.174	1.20	0.95	0.065	15.8	0.180	1.25	1.04	0.0047
79	15.4	0.177	1.23	1.00	0.067	16.3	0.184	1.29	1.10	0.0048
80	15.9	0.181	1.26	1.05	0.069	16.8	0.188	1.33	1.16	0.0049

TABLE 70—Continued

MALES						FEMALES				
Body length	Body weight	Lungs	Blood	Alimen. tract	Testes	Body weight	Lungs	Blood	Alimen. tract	Ovaries
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
81	16.4	0.185	1.30	1.11	0.071	17.3	0.192	1.36	1.21	0.0050
82	16.9	0.189	1.33	1.17	0.073	17.9	0.196	1.40	1.28	0.0051
83	17.4	0.193	1.37	1.22	0.076	18.4	0.200	1.44	1.33	0.0052
84	18.0	0.197	1.41	1.29	0.078	19.0	0.204	1.48	1.39	0.0053
85	18.5	0.201	1.45	1.34	0.081	19.5	0.208	1.52	1.44	0.0054
86	19.0	0.204	1.48	1.39	0.084	20.1	0.212	1.56	1.50	0.0055
87	19.6	0.209	1.52	1.45	0.087	20.7	0.216	1.60	1.56	0.0056
88	20.1	0.212	1.56	1.50	0.089	21.2	0.220	1.63	1.61	0.0057
89	20.7	0.216	1.60	1.56	0.093	21.8	0.224	1.68	1.67	0.0058
90	21.3	0.221	1.64	1.62	0.096	22.4	0.228	1.72	1.73	0.0058
91	21.9	0.225	1.68	1.68	0.100	23.1	0.233	1.76	1.79	0.0059
92	22.4	0.228	1.72	1.73	0.103	23.7	0.237	1.81	1.85	0.0060
93	23.0	0.232	1.76	1.78	0.107	24.3	0.241	1.85	1.90	0.0061
94	23.7	0.237	1.81	1.85	0.112	25.0	0.246	1.90	1.96	0.0062
95	24.3	0.241	1.85	1.90	0.116	25.6	0.250	1.94	2.02	0.0063
96	24.9	0.245	1.89	1.96	0.120	26.3	0.254	1.98	2.08	0.0064
97	25.6	0.250	1.94	2.02	0.125	27.0	0.259	2.03	2.14	0.0065
98	26.2	0.254	1.98	2.07	0.130	27.7	0.264	2.08	2.20	0.0066
99	26.9	0.258	2.02	2.13	0.135	28.4	0.268	2.13	2.25	0.0067
100	27.5	0.262	2.06	2.18	0.140	29.1	0.273	2.17	2.31	0.0067
101	28.2	0.267	2.11	2.24	0.145	29.8	0.277	2.22	2.37	0.0068
102	28.9	0.271	2.16	2.30	0.151	30.5	0.282	2.27	2.42	0.0069
103	29.6	0.276	2.21	2.35	0.157	31.3	0.287	2.32	2.49	0.0070
104	30.3	0.280	2.25	2.41	0.163	32.0	0.291	2.37	2.54	0.0071
105	31.1	0.285	2.31	2.47	0.171	32.8	0.296	2.42	2.60	0.0071
106	31.8	0.290	2.35	2.53	0.177	33.6	0.301	2.47	2.66	0.0072
107	32.5	0.294	2.40	2.58	0.184	34.4	0.306	2.53	2.72	0.0073
108	33.3	0.299	2.45	2.64	0.192	35.2	0.311	2.58	2.78	0.0074
109	34.1	0.304	2.51	2.70	0.200	36.0	0.316	2.63	2.84	0.0075
110	34.9	0.309	2.56	2.76	0.208	36.9	0.321	2.69	2.90	0.0075
111	35.7	0.314	2.61	2.82	0.216	37.7	0.326	2.74	2.96	0.0076
112	36.5	0.319	2.66	2.88	0.225	38.6	0.332	2.80	3.02	0.0077
113	37.3	0.324	2.72	2.93	0.234	39.5	0.337	2.86	3.09	0.0078
114	38.2	0.329	2.78	3.00	0.244	40.3	0.342	2.91	3.14	0.0078
115	39.0	0.334	2.83	3.05	0.253	41.3	0.348	2.98	3.21	0.0079
116	39.9	0.339	2.89	3.11	0.264	42.2	0.353	3.04	3.27	0.0080
117	40.8	0.345	2.95	3.17	0.275	43.1	0.358	3.09	3.33	0.0081

TABLE 70—Continued

MALES						FEMALES				
Body length	Body weight	Lungs	Blood	Alimen. tract	Testes	Body weight	Lungs	Blood	Alimen. tract	Ovaries
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
118	41.6	0.349	3.00	3.23	0.285	44.1	0.364	3.16	3.39	0.0081
119	42.6	0.355	3.06	3.29	0.298	45.0	0.369	3.22	3.45	0.0082
120	43.5	0.361	3.12	3.35	0.309	46.0	0.375	3.28	3.51	0.0083
121	44.4	0.366	3.18	3.41	0.321	47.0	0.381	3.35	3.58	0.0084
122	45.4	0.372	3.24	3.47	0.335	48.0	0.387	3.41	3.64	0.0084
123	46.3	0.377	3.30	3.53	0.348	49.1	0.393	3.48	3.71	0.0085
124	47.3	0.383	3.36	3.59	0.362	50.1	0.399	3.54	3.77	0.0086
125	48.3	0.389	3.43	3.66	0.377	51.2	0.405	3.61	3.83	0.0086
126	49.3	0.394	3.49	3.72	0.392	52.3	0.411	3.68	3.90	0.0087
127	50.4	0.401	3.56	3.78	0.408	53.4	0.418	3.75	3.96	0.0088
128	51.4	0.406	3.63	3.84	0.424	54.5	0.424	3.82	4.03	0.0089
129	52.5	0.413	3.69	3.91	0.442	55.6	0.430	3.89	4.09	0.0089
130	53.6	0.419	3.76	3.97	0.460	56.8	0.437	3.97	4.15	0.0090
131	54.7	0.425	3.83	4.04	0.478	58.0	0.444	4.04	4.22	0.0091
132	55.8	0.431	3.90	4.10	0.497	59.2	0.450	4.12	4.29	0.0091
133	56.9	0.437	3.97	4.16	0.516	60.4	0.457	4.19	4.36	0.0092
134	58.1	0.444	4.05	4.23	0.537	61.6	0.464	4.27	4.42	0.0093
135	59.3	0.451	4.12	4.30	0.559	62.9	0.471	4.35	4.49	0.0093
136	60.5	0.458	4.20	4.36	0.581	64.2	0.478	4.43	4.56	0.0094
137	61.7	0.464	4.27	4.43	0.604	65.5	0.485	4.51	4.63	0.0095
138	62.9	0.471	4.35	4.49	0.627	66.8	0.492	4.59	4.70	0.0099
139	64.1	0.477	4.42	4.56	0.651	68.1	0.499	4.67	4.77	0.0102
140	65.4	0.485	4.50	4.63	0.677	69.5	0.507	4.76	4.84	0.0106
141	66.7	0.492	4.58	4.70	0.704	70.9	0.515	4.84	4.91	0.0110
142	68.0	0.499	4.66	4.76	0.731	72.3	0.522	4.93	4.98	0.0115
143	69.3	0.506	4.74	4.83	0.759	73.7	0.530	5.01	5.05	0.0120
144	70.7	0.514	4.83	4.90	0.790	75.2	0.538	5.11	5.13	0.0126
145	72.1	0.521	4.92	4.97	0.821	76.7	0.546	5.20	5.20	0.0132
146	73.5	0.529	5.00	5.04	0.853	78.2	0.554	5.29	5.27	0.0139
147	74.9	0.536	5.09	5.11	0.885	79.7	0.562	5.38	5.35	0.0147
148	76.3	0.544	5.17	5.18	0.918	81.3	0.571	5.48	5.42	0.0155
149	77.8	0.552	5.27	5.26	0.955	82.8	0.579	5.57	5.50	0.0164
150	79.3	0.560	5.36	5.34	0.991	84.4	0.587	5.67	5.57	0.0173
151	80.8	0.568	5.45	5.40	1.031	86.1	0.596	5.77	5.65	0.0184
152	82.4	0.577	5.54	5.48	1.055	87.7	0.605	5.86	5.72	0.0195
153	83.9	0.585	5.64	5.55	1.078	89.4	0.614	5.97	5.80	0.0207

TABLE 70—Continued

MALES						FEMALES				
Body length	Body weight	Lungs	Blood	Alimen. tract	Testes	Body weight	Lungs	Blood	Alimen. tract	Ovaries
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
154	85.5	0.593	5.73	5.63	1.102	91.1	0.623	6.07	5.88	0.0219
155	87.1	0.602	5.83	5.70	1.125	92.9	0.632	6.18	5.96	0.0233
156	88.7	0.610	5.92	5.77	1.148	94.6	0.641	6.28	6.04	0.0247
157	90.4	0.619	6.03	5.85	1.173	96.4	0.651	6.39	6.12	0.0262
158	92.1	0.628	6.13	5.93	1.196	98.3	0.661	6.50	6.20	0.0279
159	93.8	0.637	6.23	6.00	1.219	100.1	0.670	6.61	6.28	0.0296
160	95.6	0.646	6.34	6.08	1.243	102.0	0.680	6.72	6.46	0.0314
161	97.3	0.655	6.44	6.16	1.265	103.9	0.690	6.83	6.44	0.0334
162	99.2	0.665	6.55	6.24	1.290	105.9	0.700	6.95	6.53	0.0344
163	101.0	0.675	6.66	6.32	1.313	107.9	0.711	7.07	6.62	0.0377
164	102.8	0.684	6.77	6.40	1.335	109.9	0.721	7.18	6.70	0.0400
165	104.7	0.694	6.88	6.48	1.358	111.9	0.731	7.30	6.78	0.0411
166	106.7	0.704	7.00	6.56	1.382	114.0	0.742	7.43	6.87	0.0419
167	108.6	0.714	7.11	6.65	1.404	116.1	0.753	7.55	6.96	0.0425
168	110.6	0.725	7.23	6.73	1.428	118.3	0.764	7.68	7.05	0.0431
169	112.6	0.735	7.34	6.81	1.450	120.5	0.776	7.81	7.14	0.0435
170	114.7	0.746	7.47	6.90	1.473	122.7	0.787	7.93	7.23	0.0439
171	116.7	0.756	7.58	6.98	1.495	125.0	0.799	8.07	7.32	0.0443
172	118.9	0.768	7.71	7.07	1.519	127.3	0.811	8.20	7.41	0.0446
173	121.0	0.778	7.83	7.16	1.541	129.6	0.822	8.33	7.50	0.0449
174	123.2	0.790	7.96	7.25	1.564	132.0	0.835	8.47	7.60	0.0452
175	125.4	0.801	8.09	7.33	1.586	134.4	0.847	8.61	7.69	0.0455
176	127.7	0.813	8.22	7.43	1.609	136.8	0.859	8.75	7.78	0.0457
177	130.0	0.824	8.36	7.52	1.632	139.3	0.872	8.89	7.88	0.0459
178	132.3	0.836	8.49	7.61	1.654	141.9	0.885	9.04	7.98	0.0462
179	134.6	0.848	8.62	7.70	1.675	144.4	0.898	9.19	8.07	0.0464
180	137.0	0.860	8.76	7.79	1.698	147.1	0.911	9.34	8.18	0.0466
181	139.5	0.873	8.90	7.89	1.721	149.7	0.925	9.49	8.28	0.0468
182	142.0	0.886	9.05	7.98	1.743	152.4	0.938	10.22	8.38	0.0469
183	144.5	0.898	9.19	8.08	1.765	155.2	0.952	10.39	8.48	0.0471
184	147.0	0.911	9.26	8.17	1.787	158.0	0.967	10.56	8.58	0.0473
185	149.6	0.924	9.33	8.27	1.809	160.8	0.981	10.73	8.69	0.0474
186	152.3	0.938	9.40	8.37	1.832	163.7	0.995	10.90	8.79	0.0476
187	155.0	0.951	9.50	8.47	1.854	166.6	1.010	11.07	8.90	0.0477
188	157.7	0.965	9.64	8.57	1.876	169.6	1.025	11.25	9.01	0.0479
189	160.5	0.979	9.80	8.68	1.898	172.6	1.040	11.43	9.12	0.0480
190	163.3	0.993	9.95	8.78	1.920	175.7	1.055	11.62	9.23	0.0482

TABLE 70—Continued

	MALES					FEMALES				
Body length	Body weight	Lungs	Blood	Alimen. tract	Testes	Body weight	Lungs	Blood	Alimen. tract	Ovaries
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
191	166.2	1.008	10.11	8.88	1.942	178.8	1.071	11.80	9.34	0.0483
192	169.1	1.022	10.27	8.99	1.964	182.0	1.087	11.99	9.45	0.0484
193	172.0	1.037	10.43	9.09	1.985	185.2	1.103	12.18	9.56	0.0485
194	175.0	1.052	10.59	9.20	2.007	188.5	1.119	12.38	9.68	0.0487
195	178.1	1.067	10.76	9.31	2.030	191.9	1.136	12.58	9.80	0.0488
196	181.2	1.083	10.93	9.42	2.051	195.3	1.153	12.78	9.92	0.0489
197	184.3	1.098	11.10	9.53	2.073	198.7	1.170	12.98	10.03	0.0490
198	187.5	1.114	11.27	9.64	2.094	202.2	1.188	13.18	10.15	0.0491
199	190.8	1.131	11.45	9.76	2.117	205.8	1.206	13.39	10.28	0.0492
200	194.1	1.147	11.63	9.87	2.138	209.4	1.223	13.61	10.40	0.0493
201	197.4	1.164	11.81	9.99	2.159	213.1	1.242	13.82	10.53	0.0494
202	200.8	1.181	11.99	10.11	2.181	216.8	1.260	14.04	10.65	0.0495
203	204.3	1.198	12.18	10.23	2.203	220.7	1.279	14.26	10.78	0.0496
204	207.8	1.215	12.36	10.35	2.224	224.5	1.298	14.48	10.91	0.0497
205	211.4	1.233	12.56	10.47	2.246	228.4	1.317	14.71	11.04	0.0498
206	215.0	1.251	12.75	10.59	2.267	232.4	1.337	14.94	11.17	0.0499
207	218.7	1.269	12.95	10.71	2.289	236.5	1.357	15.18	11.31	0.0500
208	222.5	1.288	13.15	10.84	2.311	240.6	1.378	15.42	11.44	0.0501
209	226.3	1.307	13.35	10.97	2.332	244.8	1.398	15.66	11.58	0.0502
210	230.2	1.326	13.46	11.10	2.354	249.1	1.419	15.90	11.72	0.0503
211	234.1	1.346	13.76	11.23	2.375	253.4	1.441	16.15	11.86	0.0504
212	238.1	1.365	13.98	11.36	2.397	257.8	1.462	16.41	12.00	0.0505
213	242.2	1.386	14.19	11.49	2.418	262.3	1.484	16.66	12.14	0.0506
214	246.3	1.406	14.41	11.63	2.439	266.9	1.507	16.92	12.29	0.0507
215	250.5	1.426	14.63	11.76	2.461	271.5	1.530	17.19	12.44	0.0508
216	254.7	1.447	14.85	11.90	2.482	276.2	1.553	17.45	12.59	0.0508
217	259.1	1.469	15.08	12.04	2.503	281.0	1.576	17.73	12.74	0.0509
218	263.5	1.490	15.31	12.18	2.525	285.8	1.600	18.00	12.89	0.0510
219	267.9	1.512	15.54	12.32	2.546	290.8	1.624	18.28	13.05	0.0511
220	272.5	1.534	15.78	12.47	2.567	295.8	1.648	18.57	13.21	0.0512
221	277.1	1.557	16.02	12.62	2.588	300.9	1.673	18.85	13.36	0.0512
222	281.8	1.580	16.26	12.77	2.609	306.1	1.705	19.15	13.53	0.0513
223	286.5	1.603	16.55	12.91	2.630	311.3	1.724	19.44	13.69	0.0514
224	291.4	1.627	16.76	13.07	2.652	316 7	1.751	19.74	13.85	0.0515
225	296.3	1.651	17.02	13.22	2.673	322.1	1.777	20.05	14.02	0.0516
226	301.3	1.675	17.27	13.38	2.694	327.7	1.804	20.36	14.19	0.0516
227	306.4	1.700	17.54	13.54	2.715	333.3	1.831	20.67	14.36	0.0517

TABLE 70—Concluded

MALES						FEMALES				
Body length	Body weight	Lungs	Blood	Alimen. tract	Testes	Body weight	Lungs	Blood	Alimen. tract	Ovaries
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
228	311.5	1.725	17.80	13.74	2.736	339.0	1.859	20.99	14.54	0.0518
229	316.8	1.751	18.07	13.86	2.757	344.8	1.887	21.31	14.71	0.0519
230	322.1	1.777	18.34	14.02	2.778	350.7	1.916	21.64	14.89	0.0519
231	327.5	1.803	18.62	14.19	2.799	356.7	1.945	21.97	15.07	0.0520
232	333.0	1.830	18.90	14.35	2.820	362.8	1.975	22.31	15.26	0.0521
233	338.6	1.857	19.19	14.52	2.841	369.0	2.005	22.65	15.44	0.0522
234	344.3	1.885	19.47	14.68	2.862	375.3	2.035	23.00	15.63	0.0522
235	350.0	1.913	19.77	14.87	2.883	381.7	2.067	23.35	15.82	0.0523
236	355.9	1.941	20.07	15.05	2.904	388.2	2.098	23.71	16.01	0.0524
237	361.9	1.970	20.37	15.23	2.926	394.9	2.130	24.08	16.21	0.0524
238	367.9	2.000	20.68	15.41	2.946	401.6	2.163	24.45	16.41	0.0525
239	374.1	2.030	20.99	15.59	2.967	408.4	2.196	24.82	16.61	0.0526
240	380.3	2.060	21.30	15.78	2.988	415.4	2.230	25.20	16.82	0.0526
241	386.6	2.090	21.62	15.97	3.009	422.4	2.264	25.58	17.02	0.0527
242	393.1	2.122	21.95	16.16	3.030	429.6	2.298	25.98	17.23	0.0528
243	399.6	2.153	22.27	16.35	3.051	436.9	2.334	26.37	17.45	0.0529
244	406.3	2.186	22.61	16.55	3.072	444.3	2.369	26.77	17.66	0.0529
245	413.1	2.219	22.95	16.75	3.093	451.9	2.406	27.18	17.88	0.0530
246	419.9	2.251	23.28	16.95	3.113	459.5	2.443	27.60	18.10	0.0531
247	426.9	2.285	23.64	17.15	3.134	467.3	2.480	28.02	18.33	0.0531
248	434.0	2.320	23.99	17.36	3.155	475.2	2.518	28.45	18.55	0.0532
249	441.2	2.354	24.35	17.57	3.176	483.3	2.557	28.89	18.79	0.0532
250	448.5	2.390	24.71	17.78	3.197	491.5	2.597	29.32	19.02	0.0533

TABLE 71

Giving for each sex the weights of body, hypophysis, suprarenals and thyroid for each millimeter of body length. See charts 18, 19, and 20.

	MALES				FEMALES			
Body length	Body weight	Hypo-physis	Supra-renals	Thyroid	Body weight	Hypo-physis	Supra-renals	Thyroid
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
50	5.1	0.0005	0.0017	0.0015	5.0	0.0005	0.0017	0.0014
51	5.2	0.0005	0.0017	0.0015	5.1	0.0005	0.0017	0.0015
52	5.3	0.0005	0.0017	0.0015	5.3	0.0005	0.0018	0.0015
53	5.4	0.0005	0.0018	0.0016	5.5	0.0006	0.0019	0.0016
54	5.6	0.0005	0.0019	0.0016	5.8	0.0006	0.0021	0.0017
55	5.8	0.0006	0.0021	0.0017	6.2	0.0006	0.0024	0.0018
56	6.1	0.0006	0.0023	0.0018	6.5	0.0006	0.0026	0.0019
57	6.4	0.0006	0.0025	0.0018	6.9	0.0007	0.0028	0.0020
58	6.8	0.0007	0.0027	0.0019	7.2	0.0007	0.0030	0.0021
59	7.1	0.0007	0.0029	0.0020	7.6	0.0007	0.0032	0.0022
60	7.5	0.0007	0.0031	0.0021	8.0	0.0008	0.0034	0.0023
61	7.9	0.0008	0.0034	0.0022	8.4	0.0008	0.0036	0.0024
62	8.2	0.0008	0.0035	0.0023	8.7	0.0008	0.0038	0.0025
63	8.6	0.0008	0.0037	0.0024	9.1	0.0009	0.0040	0.0026
64	9.0	0.0009	0.0039	0.0025	9.5	0.0009	0.0042	0.0027
65	9.4	0.0009	0.0041	0.0026	9.9	0.0009	0.0044	0.0028
66	9.8	0.0009	0.0043	0.0027	10.3	0.0009	0.0045	0.0029
67	10.1	0.0009	0.0045	0.0028	10.8	0.0010	0.0048	0.0030
68	10.6	0.0010	0.0047	0.0030	11.2	0.0010	0.0049	0.0031
69	11.0	0.0010	0.0049	0.0031	11.6	0.0010	0.0051	0.0032
70	11.4	0.0010	0.0050	0.0032	12.0	0.0011	0.0053	0.0033
71	11.8	0.0011	0.0052	0.0033	12.5	0.0011	0.0055	0.0034
72	12.2	0.0011	0.0054	0.0034	12.9	0.0011	0.0056	0.0035
73	12.7	0.0011	0.0056	0.0035	13.4	0.0012	0.0058	0.0037
74	13.1	0.0011	0.0057	0.0036	13.9	0.0012	0.0060	0.0038
75	13.6	0.0012	0.0059	0.0037	14.3	0.0012	0.0062	0.0039
76	14.0	0.0012	0.0061	0.0038	14.8	0.0012	0.0064	0.0040
77	14.5	0.0012	0.0063	0.0039	15.3	0.0013	0.0065	0.0041
78	15.0	0.0013	0.0064	0.0041	15.8	0.0013	0.0067	0.0042
79	15.4	0.0013	0.0066	0.0042	16.3	0.0013	0.0069	0.0044
80	15.9	0.0013	0.0067	0.0043	16.8	0.0014	0.0070	0.0045
81	16.4	0.0013	0.0069	0.0044	17.3	0.0014	0.0072	0.0046
82	16.9	0.0014	0.0071	0.0045	17.9	0.0014	0.0074	0.0047
83	17.4	0.0014	0.0072	0.0046	18.4	0.0014	0.0076	0.0049

TABLE 71—Continued

	MALES				FEMALES			
Body length	Body weight	Hypophysis	Suprarenals	Thyroid	Body weight	Hypophysis	Suprarenals	Thyroid
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms*
84	18.0	0.0014	0.0074	0.0048	19.0	0.0015	0.0078	0.0050
85	18.5	0.0015	0.0076	0.0049	19.5	0.0015	0.0079	0.0051
86	19.0	0.0015	0.0078	0.0050	20.1	0.0015	0.0081	0.0052
87	19.6	0.0015	0.0079	0.0051	20.7	0.0016	0.0083	0.0054
88	20.1	0.0015	0.0081	0.0052	21.2	0.0016	0.0084	0.0055
89	20.7	0.0016	0.0083	0.0054	21.8	0.0016	0.0086	0.0056
90	21.3	0.0016	0.0084	0.0055	22.4	0.0017	0.0087	0.0058
91	21.9	0.0016	0.0086	0.0056	23.1	0.0017	0.0089	0.0059
92	22.4	0.0017	0.0087	0.0058	23.7	0.0017	0.0091	0.0060
93	23.0	0.0017	0.0089	0.0059	24.3	0.0017	0.0093	0.0062
94	23.7	0.0017	0.0091	0.0060	25.0	0.0018	0.0094	0.0063
95	24.3	0.0017	0.0093	0.0062	25.6	0.0018	0.0096	0.0064
96	24.9	0.0018	0.0094	0.0063	26.3	0.0018	0.0098	0.0066
97	25.6	0.0018	0.0096	0.0064	27.0	0.0019	0.0100	0.0067
98	26.2	0.0018	0.0098	0.0066	27.7	0.0019	0.0101	0.0069
99	26.9	0.0019	0.0099	0.0067	28.4	0.0019	0.0103	0.0070
100	27.5	0.0019	0.0101	0.0068	29.1	0.0020	0.0105	0.0072
101	28.2	0.0019	0.0103	0.0070	29.8	0.0020	0.0106	0.0073
102	28.9	0.0020	0.0104	0.0071	30.5	0.0020	0.0108	0.0075
103	29.6	0.0020	0.0106	0.0073	31.3	0.0021	0.0110	0.0076
104	30.3	0.0020	0.0108	0.0074	32.0	0.0021	0.0112	0.0078
105	31.1	0.0021	0.0109	0.0076	32.8	0.0021	0.0114	0.0079
106	31.8	0.0021	0.0111	0.0077	33.6	0.0022	0.0117	0.0081
107	32.5	0.0021	0.0113	0.0079	34.4	0.0022	0.0119	0.0082
108	33.3	0.0021	0.0114	0.0080	35.2	0.0022	0.0121	0.0084
109	34.1	0.0022	0.0116	0.0082	36.0	0.0023	0.0123	0.0085
110	34.9	0.0022	0.0118	0.0083	36.9	0.0023	0.0126	0.0087
111	35.7	0.0022	0.0120	0.0085	37.7	0.0023	0.0128	0.0089
112	36.5	0.0023	0.0121	0.0086	38.6	0.0024	0.0130	0.0090
113	37.3	0.0023	0.0123	0.0088	39.5	0.0024	0.0133	0.0092
114	38.2	0.0024	0.0125	0.0090	40.3	0.0024	0.0135	0.0094
115	39.0	0.0024	0.0126	0.0091	41.3	0.0025	0.0138	0.0096
116	39.9	0.0024	0.0128	0.0093	42.2	0.0025	0.0140	0.0097
117	40.8	0.0025	0.0130	0.0095	43.1	0.0025	0.0143	0.0099
118	41.6	0.0025	0.0132	0.0096	44.1	0.0026	0.0145	0.0101
119	42.6	0.0025	0.0134	0.0098	45.0	0.0026	0.0148	0.0102
120	43.5	0.0026	0.0135	0.0100	46.0	0.0027	0.0150	0.0104

TABLE 71—Continued

	MALES				FEMALES			
Body length	Body weight	Hypo-physis	Supra-renals	Thyroid	Body weight	Hypo-physis	Supra-renals	Thyroid
mm.	gms.	gms.	gms.	gms.	gms.	gms.	gms.	gms.
121	44.4	0.0026	0.0137	0.0101	47.0	0.0027	0.0153	0.0106
122	45.4	0.0026	0.0139	0.0103	48.0	0.0027	0.0156	0.0108
123	46.3	0.0027	0.0141	0.0105	49.1	0.0028	0.0159	0.0110
124	47.3	0.0027	0.0142	0.0106	50.1	0.0028	0.0161	0.0111
125	48.3	0.0027	0.0144	0.0108	51.2	0.0029	0.0164	0.0113
126	49.3	0.0028	0.0146	0.0110	52.3	0.0029	0.0167	0.0115
127	50.4	0.0028	0.0148	0.0112	53.4	0.0030	0.0170	0.0117
128	51.4	0.0029	0.0150	0.0114	54.5	0.0031	0.0173	0.0119
129	52.5	0.0029	0.0152	0.0116	55.6	0.0031	0.0176	0.0121
130	53.6	0.0029	0.0154	0.0117	56.8	0.0032	0.0179	0.0123
131	54.7	0.0030	0.0155	0.0119	58.0	0.0033	0.0182	0.0125
132	55.8	0.0030	0.0157	0.0121	59.2	0.0034	0.0185	0.0127
133	56.9	0.0031	0.0159	0.0123	60.4	0.0035	0.0188	0.0129
134	58.1	0.0031	0.0161	0.0125	61.6	0.0035	0.0191	0.0131
135	59.3	0.0031	0.0163	0.0127	62.9	0.0036	0.0195	0.0133
136	60.5	0.0032	0.0165	0.0129	64.2	0.0037	0.0198	0.0135
137	61.7	0.0032	0.0167	0.0131	65.5	0.0038	0.0201	0.0137
138	62.9	0.0033	0.0169	0.0133	66.8	0.0039	0.0204	0.0139
139	64.1	0.0033	0.0171	0.0135	68.1	0.0040	0.0208	0.0142
140	65.4	0.0034	0.0173	0.0137	69.5	0.0041	0.0211	0.0144
141	66.7	0.0034	0.0175	0.0139	70.9	0.0042	0.0215	0.0146
142	68.0	0.0034	0.0177	0.0141	72.3	0.0043	0.0218	0.0148
143	69.3	0.0035	0.0179	0.0143	73.7	0.0044	0.0222	0.0150
144	70.7	0.0035	0.0181	0.0146	75.2	0.0045	0.0226	0.0153
145	72.1	0.0036	0.0183	0.0148	76.7	0.0046	0.0230	0.0155
146	73.5	0.0036	0.0185	0.0150	78.2	0.0047	0.0233	0.0158
147	74.9	0.0037	0.0187	0.0152	79.7	0.0048	0.0237	0.0160
148	76.3	0.0037	0.0189	0.0155	81.3	0.0049	0.0241	0.0162
149	77.8	0.0038	0.0192	0.0157	82.8	0.0050	0.0245	0.0164
150	79.3	0.0038	0.0194	0.0159	84.4	0.0051	0.0249	0.0167
151	80.8	0.0039	0.0196	0.0161	86.1	0.0052	0.0253	0.0169
152	82.4	0.0039	0.0198	0.0164	87.7	0.0053	0.0257	0.0172
153	83.9	0.0040	0.0200	0.0166	89.4	0.0055	0.0261	0.0175
154	85.5	0.0040	0.0203	0.0169	91.1	0.0056	0.0266	0.0177
155	87.1	0.0041	0.0205	0.0171	92.9	0.0057	0.0270	0.0180
156	88.7	0.0041	0.0207	0.0173	94.6	0.0058	0.0274	0.0182
157	90.4	0.0042	0.0210	0.0176	96.4	0.0060	0.0279	0.0185

TABLE 71—Continued

	MALES				FEMALES			
Body length	Body weight	Hypo-physis	Supra-renals	Thyroid	Body weight	Hypo-physis	Supra-renals	Thyroid
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
158	92.1	0.0042	0.0212	0.0179	98.3	0.0061	0.0283	0.0188
159	93.8	0.0043	0.0214	0.0181	100.1	0.0062	0.0288	0.0190
160	95.6	0.0044	0.0217	0.0184	102.0	0.0064	0.0293	0.0193
161	97.3	0.0044	0.0219	0.0186	103.9	0.0065	0.0297	0.0196
162	99.2	0.0045	0.0222	0.0189	105.9	0.0067	0.0302	0.0199
163	101.0	0.0045	0.0224	0.0191	107.9	0.0068	0.0307	0.0201
164	102.8	0.0046	0.0226	0.0194	109.9	0.0070	0.0312	0.0204
165	104.7	0.0046	0.0229	0.0197	111.9	0.0071	0.0317	0.0207
166	106.7	0.0047	0.0231	0.0200	114.0	0.0073	0.0322	0.0210
167	108.6	0.0048	0.0234	0.0202	116.1	0.0074	0.0327	0.0213
168	110.6	0.0048	0.0236	0.0205	118.3	0.0076	0.0333	0.0216
169	112.6	0.0049	0.0239	0.0208	120.5	0.0077	0.0338	0.0219
170	114.7	0.0050	0.0242	0.0211	122.7	0.0079	0.0343	0.0222
171	116.7	0.0050	0.0244	0.0214	125.0	0.0081	0.0349	0.0225
172	118.9	0.0051	0.0247	0.0217	127.3	0.0082	0.0355	0.0228
173	121.0	0.0052	0.0250	0.0220	129.6	0.0084	0.0360	0.0232
174	123.2	0.0052	0.0252	0.0223	132.0	0.0086	0.0366	0.0235
175	125.4	0.0053	0.0255	0.0226	134.4	0.0088	0.0372	0.0238
176	127.7	0.0054	0.0258	0.0229	136.8	0.0089	0.0378	0.0241
177	130.0	0.0054	0.0261	0.0232	139.3	0.0091	0.0384	0.0245
178	132.3	0.0055	0.0264	0.0235	141.9	0.0093	0.0390	0.0248
179	134.6	0.0056	0.0266	0.0238	144.4	0.0095	0.0396	0.0251
180	137.0	0.0056	0.0269	0.0242	147.1	0.0097	0.0402	0.0255
181	139.5	0.0057	0.0272	0.0245	149.7	0.0099	0.0409	0.0258
182	142.0	0.0058	0.0275	0.0248	152.4	0.0101	0.0415	0.0262
183	144.5	0.0059	0.0278	0.0252	155.2	0.0103	0.0422	0.0266
184	147.0	0.0059	0.0281	0.0255	158.0	0.0105	0.0429	0.0269
185	149.6	0.0060	0.0284	0.0258	160.8	0.0108	0.0435	0.0273
186	152.3	0.0061	0.0287	0.0262	163.7	0.0110	0.0442	0.0277
187	155.0	0.0062	0.0291	0.0265	166.6	0.0112	0.0449	0.0280
188	157.7	0.0063	0.0294	0.0269	169.6	0.0114	0.0457	0.0284
189	160.5	0.0063	0.0297	0.0272	172.6	0.0117	0.0464	0.0288
190	163.3	0.0064	0.0300	0.0276	175.7	0.0119	0.0471	0.0292
191	166.2	0.0065	0.0304	0.0280	178.8	0.0121	0.0479	0.0296
192	169.1	0.0066	0.0307	0.0284	182.0	0.0124	0.0486	0.0300
193	172.0	0.0067	0.0310	0.0287	185.2	0.0126	0.0494	0.0304

TABLE 71—Continued

	MALES				FEMALES			
Body length	Body weight	Hypophysis	Suprarenals	Thyroid	Body weight	Hypophysis	Suprarenals	Thyroid
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
194	175.0	0.0068	0.0314	0.0291	188.5	0.0129	0.0502	0.0308
195	178.1	0.0068	0.0317	0.0295	191.9	0.0131	0.0510	0.0312
196	181.2	0.0069	0.0321	0.0299	195.3	0.0134	0.0518	0.0317
197	184.3	0.0070	0.0324	0.0303	198.7	0.0136	0.0526	0.0321
198	187.5	0.0071	0.0328	0.0307	202.2	0.0139	0.0535	0.0325
199	190.8	0.0072	0.0331	0.0311	205.8	0.0142	0.0543	0.0330
200	194.1	0.0073	0.0335	0.0315	209.4	0.0145	0.0552	0.0334
201	197.4	0.0074	0.0338	0.0319	213.1	0.0148	0.0560	0.0339
202	200.8	0.0075	0.0342	0.0323	216.8	0.0150	0.0569	0.0343
203	204.3	0.0076	0.0346	0.0328	220.7	0.0153	0.0579	0.0348
204	207.8	0.0077	0.0350	0.0332	224.5	0.0155	0.0588	0.0352
205	211.4	0.0078	0.0354	0.0336	228.4	0.0159	0.0597	0.0357
206	215.0	0.0079	0.0358	0.0341	232.4	0.0162	0.0606	0.0362
207	218.7	0.0080	0.0362	0.0345	236.5	0.0166	0.0616	0.0367
208	222.5	0.0081	0.0366	0.0350	240.6	0.0169	0.0626	0.0372
209	226.3	0.0082	0.0370	0.0355	344.8	0.0172	0.0636	0.0377
210	230.2	0.0083	0.0374	0.0359	249.1	0.0175	0.0646	0.0382
211	234.1	0.0084	0.0378	0.0364	253.4	0.0179	0.0656	0.0387
212	238.1	0.0086	0.0382	0.0369	257.8	0.0182	0.0667	0.0392
213	242.2	0.0087	0.0387	0.0374	262.3	0.0186	0.0677	0.0398
214	246.3	0.0088	0.0391	0.0379	266.9	0.0189	0.0688	0.0403
215	250.5	0.0089	0.0395	0.0384	271.5	0.0193	0.0699	0.0408
216	254.7	0.0090	0.0400	0.0389	276.2	0.0196	0.0710	0.0414
217	259.1	0.0092	0.0404	0.0394	281.0	0.0200	0.0721	0.0420
218	263.5	0.0093	0.0409	0.0399	285.8	0.0204	0.0733	0.0425
219	267.9	0.0094	0.0414	0.0404	290.8	0.0208	0.0744	0.0431
220	272.5	0.0095	0.0418	0.0410	295.8	0.0212	0.0756	0.0437
221	277.1	0.0097	0.0423	0.0415	300.9	0.0216	0.0768	0.0443
222	281.8	0.0098	0.0428	0.0421	306.1	0.0220	0.0781	0.0449
223	286.5	0.0099	0.0433	0.0426	311.3	0.0224	0.0793	0.0455
224	291.4	0.0101	0.0438	0.0432	316.7	0.0228	0.0805	0.0461
225	296.3	0.0102	0.0443	0.0437	322.1	0.0232	0.0818	0.0467
226	301.3	0.0103	0.0448	0.0443	327.7	0.0237	0.0831	0.0474
227	306.4	0.0105	0.0453	0.0449	333.3	0.0242	0.0845	0.0480
228	311.5	0.0106	0.0458	0.0455	339.0	0.0246	0.0858	0.0486
229	316.8	0.0108	0.0464	0.0461	344.8	0.0250	0.0872	0.0493
230	322.1	0.0109	0.0469	0.0467	350.7	0.0255	0.0885	0.0500

TABLE 71—Concluded

	MALES				FEMALES			
Body length	Body weight	Hypophysis	Suprarenals	Thyroid	Body weight	Hypophysis	Suprarenals	Thyroid
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
231	327.5	0.0111	0.0474	0.0473	356.7	0.0259	0.0899	0.0507
232	333.0	0.0112	0.0480	0.0480	362.8	0.0264	0.0914	0.0513
233	338.6	0.0114	0.0485	0.0486	369.0	0.0269	0.0928	0.0520
234	344.3	0.0115	0.0491	0.0493	375.3	0.0274	0.0943	0.0527
235	350.0	0.0117	0.0497	0.0499	381.7	0.0279	0.0958	0.0535
236	355.9	0.0118	0.0503	0.0506	388.2	0.0284	0.0973	0.0542
237	361.9	0.0120	0.0509	0.0512	394.9	0.0290	0.0989	0.0549
238	367.9	0.0122	0.0514	0.0519	401.6	0.0295	0.1005	0.0557
239	374.1	0.0123	0.0521	0.0526	408.4	0.0300	0.1021	0.0564
240	380.3	0.0125	0.0527	0.0533	415.4	0.0306	0.1037	0.0572
241	386.6	0.0127	0.0533	0.0540	422.4	0.0311	0.1053	0.0580
242	393.1	0.0129	0.0539	0.0548	429.6	0.0317	0.1070	0.0588
243	399.6	0.0130	0.0546	0.0555	436.9	0.0323	0.1087	0.0596
244	406.3	0.0132	0.0552	0.0562	444.3	0.0329	0.1105	0.0604
245	413.1	0.0134	0.0559	0.0570	451.9	0.0335	0.1122	0.0613
246	419.9	0.0136	0.0565	0.0577	459.5	0.0341	0.1140	0.0621
247	426.9	0.0138	0.0572	0.0585	467.3	0.0347	0.1158	0.0630
248	434.0	0.0140	0.0579	0.0593	475.2	0.0353	0.1177	0.0638
249	441.2	0.0142	0.0586	0.0601	483.3	0.0359	0.1196	0.0647
250	448.5	0.0144	0.0593	0.0609	491.5	0.0366	0.1251	0.0656

TABLE 72

Giving the weight of the thymus in grams —sexes combined—for the first 400 days of life. See Chart 23

AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS
B.	0.008	38	0.114	75	0.283	113	0.250
1	0.008	39	0.118	76	0.285	114	0.249
2	0.010	40	0.123	77	0.286	115	0.247
3	0.012	41	0.128	78	0.288	116	0.246
4	0.015	42	0.133	79	0.289	117	0.245
5	0.017	43	0.139	80	0.290	118	0.244
6	0.018	44	0.144	81	0.290	119	0.243
7	0.020	45	0.149	82	0.291	120	0.242
8	0.021	46	0.154	83	0.291	121	0.241
9	0.022	47	0.160	84	0.290	122	0.240
10	0.024	48	0.165	85	0.290	123	0.239
11	0.026	49	0.171	86	0.289	124	0.238
12	0.028	50	0.176	87	0.288	125	0.237
13	0.029	51	0.181	88	0.287	126	0.236
14	0.031	52	0.187	89	0.285	127	0.234
15	0.034	53	0.192	90	0.283	128	0.233
16	0.036	54	0.198	91	0.281	129	0.232
17	0.038	55	0.203	92	0.278	130	0.231
18	0.040	56	0.208	93	0.276	131	0.230
19	0.043	57	0.213	94	0.273	132	0.229
20	0.046	58	0.218	95	0.270	133	0.228
21	0.048	59	0.224	96	0.269	134	0.227
22	0.051	60	0.229	97	0.268	135	0.226
23	0.054	61	0.233	98	0.266	136	0.225
24	0.057	62	0.238	99	0.265	137	0.224
25	0.061	63	0.243	100	0.264	138	0.223
26	0.064	64	0.247	101	0.263	139	0.222
27	0.067	65	0.251	102	0.262	140	0.221
28	0.071	66	0.255	103	0.261	141	0.220
29	0.075	67	0.259	104	0.260	142	0.219
30	0.079	68	0.263	105	0.259	143	0.218
31	0.083	69	0.267	106	0.257	144	0.217
32	0.087	70	0.270	107	0.256	145	0.216
33	0.091	71	0.273	108	0.255	146	0.215
34	0.095	72	0.276	109	0.254	147	0.214
35	0.100	73	0.278	110	0.253	148	0.213
36	0.104	74	0.281	111	0.252	149	0.212
37	0.109			112	0.251	150	0.211

TABLE 72—Continued

AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT IN THYMUS
151	0.210	191	0.172	231	0.138	271	0.108
152	0.209	192	0.171	232	0.137	272	0.107
153	0.208	193	0.170	233	0.136	273	0.106
154	0.207	194	0.169	234	0.135	274	0.106
155	0.206	195	0.168	235	0.134	275	0.105
156	0.205	196	0.167	236	0.134	276	0.104
157	0.204	197	0.166	237	0.133	277	0.104
158	0.203	198	0.165	238	0.132	278	0.103
159	0.202	199	0.164	239	0.131	279	0.102
160	0.201	200	0.164	240	0.130	280	0.102
161	0.200	201	0.163	241	0.130	281	0.101
162	0.199	202	0.162	242	0.129	282	0.100
163	0.198	203	0.161	243	0.128	283	0.099
164	0.197	204	0.160	244	0.127	284	0.099
165	0.196	205	0.159	245	0.127	285	0.098
166	0.195	206	0.158	246	0.126	286	0.098
167	0.194	207	0.157	247	0.125	287	0.097
168	0.193	208	0.157	248	0.124	288	0.096
169	0.192	209	0.156	249	0.124	289	0.096
170	0.191	210	0.155	250	0.123	290	0.095
171	0.190	211	0.154	251	0.122	291	0.094
172	0.189	212	0.153	252	0.121	292	0.094
173	0.188	213	0.152	253	0.121	293	0.093
174	0.187	214	0.152	254	0.120	294	0.092
175	0.186	215	0.151	255	0.119	295	0.092
176	0.185	216	0.150	256	0.118	296	0.091
177	0.184	217	0.149	257	0.118	297	0.090
178	0.183	218	0.148	258	0.117	298	0.090
179	0.183	219	0.147	259	0.116	299	0.089
180	0.182	220	0.147	260	0.115	300	0.089
181	0.181	221	0.146	261	0.115	301	0.088
182	0.180	222	0.145	262	0.114	302	0.087
183	0.179	223	0.144	263	0.113	303	0.087
184	0.178	224	0.143	264	0.113	304	0.086
185	0.177	225	0.142	265	0.112	305	0.085
186	0.176	226	0.142	266	0.111	306	0.085
187	0.175	227	0.141	267	0.110	307	0.084
188	0.174	228	0.140	268	0.110	308	0.084
189	0.173	229	0.139	269	0.109	309	0.083
190	0.172	230	0.138	270	0.108	310	0.082

TABLE 72—Concluded

AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS	AGE IN DAYS	WEIGHT OF THYMUS
311	0.082	334	0.069	357	0.057	379	0.047
312	0.081	335	0.068	358	0.057	380	0.047
313	0.081	336	0.068	359	0.056		
314	0.080	337	0.067	360	0.056	381	0.047
315	0.080	338	0.067			382	0.046
316	0.079	339	0.066	361	0.055	383	0.046
317	0.078	340	0.066	362	0.055	384	0.045
318	0.078			363	0.054	385	0.045
319	0.077	341	0.065	364	0.054	386	0.045
320	0.077	342	0.065	365	0.054	387	0.044
		343	0.064	366	0.053	388	0.044
321	0.076	344	0.064	367	0.053	389	0.043
322	0.075	345	0.063	368	0.052	390	0.043
323	0.075	346	0.063	369	0.052		
324	0.074	347	0.062	370	0.051	391	0.043
325	0.074	348	0.062			392	0.042
326	0.073	349	0.061	371	0.051	393	0.042
327	0.073	350	0.061	372	0.050	394	0.041
328	0.072			373	0.050	395	0.041
329	0.072	351	0.060	374	0.050	396	0.041
330	0.071	352	0.060	375	0.049	397	0.040
		353	0.059	376	0.049	398	0.040
331	0.071	354	0.059	377	0.048	399	0.040
332	0.070	355	0.058	378	0.048	400	0.039
333	0.069	356	0.058				

TABLE 73

Weights of viscera combined plus that of thymus for each sex and at each millimeter of body length. Not charted. The percentage of the body weight represented by the weight of the viscera is however given under 'viscera' in table 50, and chart 5.

MALES				FEMALES		
Body length	Body weight	Weight of viscera	Weight of thymus	Body weight	Weight of viscera	Weight of thymus
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
47	4.9	0.806	0.007	4.7	0.775	0.007
48	4.9	0.808	0.007	4.7	0.779	0.007
49	5.0	0.839	0.007	4.9	0.810	0.007
50	5.1	0.853	0.007	5.0	0.834	0.008
51	5.2	0.873	0.008	5.1	0.854	0.008
52	5.3	0.916	0.008	5.3	0.901	0.008
53	5.4	0.938	0.008	5.5	0.955	0.008
54	5.6	0.991	0.008	5.8	1.046	0.010
55	5.8	1.047	0.010	6.2	1.141	0.012
56	6.1	1.130	0.011	6.5	1.218	0.015
57	6.4	1.218	0.012	6.9	1.318	0.015
58	6.8	1.301	0.015	7.2	1.401	0.016
59	7.1	1.387	0.015	7.6	1.487	0.017
60	7.5	1.486	0.016	8.0	1.573	0.017
61	7.9	1.573	0.016	8.4	1.665	0.018
62	8.2	1.656	0.017	8.7	1.735	0.020
63	8.6	1.751	0.017	9.1	1.825	0.020
64	9.0	1.837	0.018	9.5	1.914	0.020
65	9.4	1.931	0.020	9.9	1.998	0.021
66	9.8	2.026	0.020	10.3	2.114	0.021
67	10.1	2.091	0.021	10.8	2.300	0.021
68	10.6	2.272	0.021	11.2	2.467	0.022
69	11.0	2.441	0.022	11.6	2.622	0.023
70	11.4	2.614	0.022	12.0	2.787	0.024
71	11.8	2.770	0.023	12.5	2.958	0.025
72	12.2	2.911	0.024	12.9	3.093	0.026
73	12.7	3.093	0.025	13.4	3.270	0.026
74	13.1	3.226	0.026	13.9	3.424	0.027
75	13.6	3.396	0.027	14.3	3.554	0.027
76	14.0	3.524	0.028	14.8	3.704	0.028
77	14.5	3.679	0.028	15.3	3.864	0.028
78	15.0	3.842	0.029	15.8	4.001	0.031
79	15.4	3.967	0.031	16.3	4.147	0.032
80	15.9	4.107	0.032	16.8	4.294	0.033

TABLE 73—Continued

MALES				FEMALES		
Body length	Body weight	Weight of viscera	Weight of thymus	Body weight	Weight of viscera	Weight of thymus
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
81	16.4	4.255	0.034	17.3	4.419	0.034
82	16.9	4.393	0.036	17.9	4.584	0.034
83	17.4	4.529	0.038	18.4	4.717	0.035
84	18.0	4.698	0.037	19.0	4.864	0.037
85	18.5	4.834	0.040	19.5	4.996	0.038
86	19.0	4.958	0.041	20.1	5.138	0.040
87	19.6	5.115	0.043	20.7	5.283	0.043
88	20.1	5.239	0.044	21.2	5.413	0.044
89	20.7	5.385	0.046	21.8	5.555	0.046
90	21.3	5.531	0.048	22.4	5.697	0.048
91	21.9	5.679	0.050	23.1	5.840	0.050
92	22.4	5.809	0.052	23.7	5.983	0.052
93	23.0	5.943	0.054	24.3	6.112	0.054
94	23.7	6.102	0.056	25.0	6.266	0.055
95	24.3	6.236	0.057	25.6	6.396	0.057
96	24.9	6.381	0.059	26.3	6.547	0.059
97	25.6	6.528	0.061	27.0	6.687	0.060
98	26.2	6.672	0.063	27.7	6.831	0.061
99	26.9	6.810	0.065	28.4	6.972	0.063
100	27.5	6.942	0.067	29.1	7.112	0.065
101	28.2	7.088	0.070	29.8	7.254	0.067
102	28.9	7.237	0.073	30.5	7.384	0.067
103	29.6	7.372	0.075	31.3	7.537	0.075
104	30.3	7.517	0.078	32.0	7.666	0.079
105	31.1	7.678	0.081	32.8	7.820	0.083
106	31.8	7.824	0.083	33.6	7.960	0.087
107	32.5	7.959	0.086	34.4	8.112	0.091
108	33.3	8.110	0.089	35.2	8.254	0.095
109	34.1	8.268	0.092	36.0	8.395	0.097
110	34.9	8.418	0.095	36.9	8.546	0.099
111	35.7	8.566	0.099	37.7	8.690	0.101
112	36.5	8.727	0.104	38.6	8.841	0.105
113	37.3	8.866	0.109	39.5	9.005	0.109
114	38.2	9.037	0.111	40.3	9.134	0.113
115	39.0	9.177	0.113	41.3	9.300	0.117
116	39.9	9.330	0.116	42.2	9.451	0.120
117	40.8	9.493	0.118	43.1	9.595	0.123

TABLE 73—Continued

MALES				FEMALES		
Body length	Body weight	Weight of viscera	Weight of thymus	Body weight	Weight of viscera	Weight of thymus
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
118	41.6	9.644	0.120	44.1	9.746	0.126
119	42.6	9.810	0.123	45.0	9.888	0.130
120	43.5	9.964	0.127	46.0	10.043	0.133
121	44.4	10.127	0.131	47.0	10.207	0.136
122	45.4	10.294	0.135	48.0	10.360	0.139
123	46.3	10.448	0.139	49.1	10.525	0.144
124	47.3	10.616	0.140	50.1	10.679	0.147
125	48.3	10.794	0.141	51.2	10.832	0.151
126	49.3	10.950	0.142	52.3	10.999	0.154
127	50.4	11.134	0.144	53.4	11.156	0.159
128	51.4	11.290	0.149	54.5	11.320	0.164
129	52.5	11.474	0.154	55.6	11.474	0.167
130	53.6	11.644	0.159	56.8	11.640	0.171
131	54.7	11.827	0.164	58.0	11.808	0.174
132	55.8	12.002	0.167	59.2	11.984	0.178
133	56.9	12.174	0.171	60.4	12.150	0.181
134	58.1	12.373	0.175	61.6	12.306	0.184
135	59.3	12.560	0.178	62.9	12.485	0.187
136	60.5	12.740	0.181	64.2	12.663	0.190
137	61.7	12.936	0.184	65.5	12.829	0.193
138	62.9	13.116	0.187	66.8	13.007	0.196
139	64.1	13.305	0.192	68.1	13.176	0.199
140	65.4	13.509	0.196	69.5	13.356	0.203
141	66.7	13.703	0.200	70.9	13.536	0.206
142	68.0	13.898	0.203	72.3	13.715	0.210
143	69.3	14.093	0.208	73.7	13.898	0.214
144	70.7	14.303	0.211	75.2	14.089	0.218
145	72.1	14.513	0.214	76.7	14.281	0.225
146	73.5	14.723	0.218	78.2	14.464	0.233
147	74.9	14.934	0.220	79.7	14.654	0.236
148	76.3	15.147	0.223	81.3	14.848	0.239
149	77.8	15.374	0.226	82.8	15.038	0.243
150	79.3	15.600	0.229	84.4	15.222	0.247
151	80.8	15.811	0.231	86.1	15.427	0.249
152	82.4	16.039	0.233	87.7	15.612	0.251
153	83.9	16.241	0.236	89.4	15.819	0.252

TABLE 73—Continued

MALES				FEMALES		
Body length	Body weight	Weight of viscera	Weight of thymus	Body weight	Weight of viscera	Weight of thymus
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
154	85.5	16.456	0.239	91.1	16.023	0.253
155	87.1	16.672	0.241	92.9	16.230	0.254
156	88.7	16.877	0.244	94.6	16.435	0.256
157	90.4	17.104	0.247	96.4	16.645	0.262
158	92.1	17.321	0.249	98.3	16.854	0.269
159	93.8	17.537	0.251	100.1	17.062	0.270
160	95.6	17.770	0.253	102.0	17.270	0.273
161	97.3	17.995	0.256	103.9	17.489	0.276
162	99.2	18.227	0.259	105.9	17.710	0.278
163	101.0	18.456	0.262	107.9	17.943	0.280
164	102.8	18.682	0.264	109.9	18.165	0.283
165	104.7	18.912	0.267	111.9	18.376	0.285
166	106.7	19.155	0.270	114.0	18.607	0.286
167	108.6	19.391	0.272	116.1	18.840	0.288
168	110.6	19.638	0.274	118.3	19.073	0.289
169	112.6	19.868	0.276	120.5	19.318	0.290
170	114.7	20.121	0.278	122.7	19.549	0.291
171	116.7	20.363	0.280	125.0	19.784	0.290
172	118.9	20.620	0.282	127.3	20.030	0.289
173	121.0	20.870	0.285	129.6	20.266	0.288
174	123.2	21.127	0.286	132.0	20.522	0.288
175	125.4	21.368	0.288	134.4	20.767	0.287
176	127.7	21.647	0.289	136.8	21.015	0.284
177	130.0	21.905	0.290	139.3	21.273	0.278
178	132.3	22.160	0.291	141.9	21.532	0.273
179	134.6	22.425	0.291	144.4	21.781	0.268
180	137.0	22.693	0.291	147.1	22.062	0.266
181	139.5	22.972	0.290	149.7	22.322	0.264
182	142.0	23.244	0.290	152.4	22.594	0.262
183	144.5	23.521	0.290	155.2	22.867	0.256
184	147.0	23.791	0.287	158.0	23.142	0.251
185	149.6	24.073	0.285	160.8	23.424	0.248
186	152.3	24.367	0.278	163.7	23.700	0.247
187	155.0	24.648	0.274	166.6	23.995	0.245
188	157.7	24.943	0.271	169.6	24.282	0.238
189	160.5	25.246	0.268	172.6	24.579	0.235
190	163.3	25.541	0.266	175.7	24.876	0.232

TABLE 73—Continued

MALES				FEMALES		
Body length	Body weight	Weight of viscera	Weight of thymus	Body weight	Weight of viscera	Weight of thymus
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
191	166.2	25.838	0.264	178.8	25.166	0.230
192	169.1	26.144	0.262	182.0	25.475	0.223
193	172.0	26.450	0.259	185.2	25.778	0.211
194	175.0	26.756	0.256	188.5	26.089	0.190
195	178.1	27.077	0.253	191.9	26.414	0.183
196	181.2	27.396	0.251	195.3	26.736	0.171
197	184.3	27.716	0.249	198.7	27.051	
198	187.5	28.036	0.247	202.2	27.378	
199	190.8	28.370	0.245	205.8	27.716	
200	194.1	28.692	0.241	209.4	28.051	
201	197.4	29.035	0.238	213.1	28.380	
202	200.8	29.379	0.230	216.8	28.731	
203	204.3	29.726	0.226	220.7	29.083	
204	207.8	30.071	0.224	224.5	29.433	
205	211.4	30.418	0.222	228.4	29.795	
206	215.0	30.767	0.220	232.4	30.150	
207	218.7	31.127	0.218	236.5	30.526	
208	222.5	31.499	0.210	240.6	30.893	
209	226.3	31.871	0.205	244.8	31.272	
210	230.2	32.244	0.197	249.1	31.661	
211	234.1	32.616	0.190	253.4	32.042	
212	238.1	33.002	0.183	257.8	32.432	
213	242.2	33.389	0.177	262.3	32.825	
214	246.3	33.784	0.169	266.9	33.230	
215	250.5	34.172	0.150	271.5	33.645	
216	254.7	34.570	0.140	276.2	34.053	
217	259.1	34.982	0.130	281.0	34.470	
218	263.5	35.384	0.124	285.8	34.888	
219	267.9	35.785	0.118	290.8	35.331	
220	272.5	36.219		295.8	35.774	
221	277.1	36.654		300.9	36.198	
222	281.8	37.082		306.1	36.670	
223	286.5	37.507		311.3	37.109	
224	291.4	37.958		316.7	37.568	
225	296.3	38.339		322.1	38.028	
226	301.3	38.861		327.7	38.510	
227	306.4	39.325		333.3	38.982	

TABLE 73—Concluded

MALES				FEMALES		
Body length	Body weight	Weight of viscera	Weight of thymus	Body weight	Weight of viscera	Weight of thymus
mm.	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*	*gms.*
228	311.5	39.828		339.0	39.476	
229	316.8	40.255		344.8	39.963	
230	322.1	40.723		350.7	40.462	
231	327.5	41.210		356.7	40.972	
232	333.0	41.692		362.8	41.492	
233	338.6	42.194		369.0	42.006	
234	344.3	42.678		375.3	42.531	
235	350.0	43.201		381.7	43.068	
236	355.9	43.718		388.2	43.605	
237	361.9	44.250		394.9	44.168	
238	367.9	44.769		401.6	44.731	
239	374.1	45.301		408.4	45.295	
240	380.3	45.854		415.4	45.882	
241	386.6	46.398		422.4	46.451	
242	393.1	46.957		429.6	47.041	
243	399.6	47.514		436.9	47.655	
244	406.3	48.097		444.3	48.258	
245	413.1	48.678		451.9	48.876	
246	419.9	49.262		459.5	49.506	
247	426.9	49.838		467.3	50.147	
248	434.0	50.456		475.2	50.780	
249	441.2	51.066		483.3	51.446	
250	448.5	51.689		491.5	52.105	

TABLE 74

Giving the percentage of water in the brain and in the spinal cord for each sex, on age. See Chart 26.

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord
B	4.7	0.217	88.00	0.033	86.75	4.6	0.213	88.00	0.033	86.75
1	5.5	0.290	87.95	0.038	86.42	5.4	0.269	87.95	0.037	86.42
2	5.9	0.333	87.90	0.041	86.08	5.8	0.323	87.90	0.041	86.08
3	6.4	0.395	87.85	0.046	85.74	6.3	0.373	87.85	0.045	85.74
4	6.9	0.442	87.83	0.050	85.41	6.8	0.421	87.83	0.050	85.41
5	7.6	0.509	87.79	0.056	85.07	7.5	0.492	87.79	0.056	85.07
6	8.5	0.581	87.70	0.064	84.73	8.4	0.564	87.70	0.064	84.73
7	9.5	0.657	87.50	0.072	84.40	9.4	0.645	87.50	0.073	84.40
8	10.5	0.708	87.30	0.081	84.06	10.4	0.697	87.30	0.082	84.06
9	11.8	0.840	87.05	0.091	83.73	11.6	0.811	87.05	0.091	83.73
10	13.5	0.947	86.72	0.104	83.40	13.0	0.909	86.72	0.102	83.40
11	13.9	0.969	86.26	0.106	82.98	13.7	0.940	86.26	0.107	82.96
12	14.4	0.991	85.82	0.110	82.57	14.4	0.979	85.82	0.112	82.52
13	14.9	1.011	85.39	0.114	82.17	15.1	1.003	85.40	0.117	82.10
14	15.5	1.037	84.97	0.118	81.77	15.8	1.031	84.98	0.122	81.68
15	16.1	1.057	84.58	0.122	81.39	16.5	1.048	84.59	0.127	81.28
16	16.7	1.077	84.19	0.126	81.00	17.3	1.079	84.20	0.133	80.88
17	17.3	1.095	83.82	0.131	80.63	18.1	1.099	83.82	0.138	80.49
18	18.0	1.112	83.46	0.135	80.26	18.9	1.118	83.47	0.142	80.11
19	18.7	1.131	83.12	0.139	79.90	19.8	1.140	83.13	0.148	79.73
20	19.5	1.150	82.80	0.144	79.55	20.7	1.159	82.82	0.154	79.47
21	20.3	1.169	82.49	0.149	79.21	21.6	1.177	82.51	0.160	79.02
22	21.1	1.184	82.19	0.154	78.87	22.5	1.195	82.21	0.165	78.67
23	22.0	1.202	81.91	0.159	78.54	23.4	1.208	81.93	0.170	78.33
24	22.9	1.219	81.64	0.165	78.22	24.4	1.226	81.66	0.176	78.00
25	23.9	1.237	81.39	0.169	77.90	25.4	1.241	81.41	0.182	77.67
26	24.9	1.252	81.15	0.175	77.59	26.5	1.251	81.17	0.187	77.36
27	25.9	1.266	80.93	0.179	77.29	27.5	1.269	80.95	0.193	77.06
28	27.0	1.282	80.72	0.186	77.00	28.6	1.282	80.74	0.198	76.76
29	28.1	1.297	80.53	0.193	76.71	29.7	1.297	80.55	0.204	76.47
30	29.2	1.311	80.35	0.198	76.43	30.9	1.310	80.37	0.210	76.19
31	30.4	1.324	80.19	0.204	76.16	32.0	1.322	80.21	0.216	75.92
32	31.6	1.338	80.04	0.210	75.90	33.2	1.334	80.07	0.221	75.66
33	32.8	1.351	79.91	0.215	75.64	34.4	1.346	79.94	0.227	75.40
34	34.1	1.363	79.79	0.221	75.39	35.7	1.358	79.82	0.233	75.16
35	35.4	1.375	79.69	0.227	75.15	37.0	1.369	79.72	0.239	74.92
36	36.8	1.389	79.60	0.233	74.91	38.3	1.380	79.63	0.245	74.69

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weignt *gms.*	Per cent of water cord
37	38.1	1.399	79.52	0.239	74.68	39.6	1.391	79.55	0.250	74.47
38	39.6	1.411	79.46	0.245	74.46	40.9	1.400	79.49	0.255	74.26
39	41.0	1.423	79.42	0.251	74.25	42.3	1.411	79.45	0.261	74.06
40	42.5	1.434	79.39	0.257	74.04	43.7	1.422	79.42	0.267	73.86
41	44.1	1.446	79.36	0.264	73.95	45.1	1.432	79.39	0.272	73.78
42	45.7	1.457	79.34	0.269	73.87	46.6	1.441	79.37	0.278	73.72
43	47.3	1.468	79.32	0.276	73.74	48.1	1.451	79.35	0.284	73.60
44	48.9	1.478	79.30	0.281	73.62	49.6	1.460	79.33	0.289	73.50
45	50.6	1.488	79.28	0.288	73.50	51.1	1.468	79.31	0.294	73.39
46	52.3	1.498	79.26	0.293	73.39	52.7	1.478	79.29	0.300	73.30
47	54.1	1.507	79.24	0.299	73.28	54.3	1.487	79.27	0.306	73.21
48	55.9	1.518	79.22	0.305	73.17	55.9	1.495	79.25	0.311	73.12
49	57.7	1.527	79.21	0.311	73.07	57.5	1.503	79.24	0.316	72.05
50	59.6	1.537	79.19	0.317	72.97	59.2	1.512	79.23	0.322	72.97
51	61.5	1.546	79.17	0.323	72.88	60.9	1.520	79.21	0.327	72.88
52	63.4	1.555	79.15	0.329	72.79	62.6	1.528	79.19	0.332	72.79
53	65.4	1.563	79.14	0.334	72.69	64.3	1.535	79.18	0.338	72.69
54	67.4	1.572	79.12	0.340	72.60	66.1	1.543	79.16	0.343	72.60
55	69.5	1.581	79.10	0.346	72.51	67.9	1.551	79.14	0.348	72.51
56	71.6	1.589	79.08	0.352	72.43	69.7	1.558	79.12	0.353	72.43
57	73.7	1.597	79.07	0.358	72.35	71.6	1.565	79.11	0.359	72.35
58	75.9	1.606	79.05	0.363	72.27	73.4	1.573	79.09	0.364	72.27
59	78.1	1.614	79.04	0.369	72.19	75.3	1.580	79.08	0.370	72.19
60	80.3	1.622	79.02	0.375	72.11	77.3	1.587	79.06	0.375	72.11
61	82.5	1.629	79.00	0.380	72.04	79.2	1.594	79.04	0.380	72.04
62	84.9	1.637	78.99	0.386	71.97	81.2	1.601	79.02	0.385	71.97
63	87.2	1.644	78.97	0.391	71.91	83.2	1.607	79.01	0.389	71.91
64	89.6	1.652	78.96	0.397	71.84	85.2	1.614	78.99	0.394	71.84
65	92.0	1.659	78.94	0.402	71.77	87.3	1.621	78.98	0.399	71.77
66	94.5	1.666	78.93	0.407	71.71	89.4	1.627	78.97	0.404	71.72
67	97.0	1.673	78.92	0.413	71.65	91.5	1.633	78.96	0.409	71.66
68	99.5	1.681	78.90	0.418	71.60	93.6	1.639	78.94	0.414	71.61
69	102.1	1.688	78.89	0.424	71.54	95.8	1.645	78.93	0.419	71.54
70	104.7	1.695	78.88	0.429	71.48	98.0	1.651	78.92	0.424	71.50
71	107.3	1.702	78.87	0.434	71.43	100.2	1.657	78.91	0.429	71.45
72	110.0	1.709	78.85	0.439	71.38	102.4	1.663	78.89	0.433	71.41
73	112.7	1.715	78.84	0.445	71.32	104.7	1.669	78.88	0.438	71.36
74	115.5	1.722	78.82	0.450	71.27	107.0	1.675	78.86	0.442	71.32

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weight *gms.*	Per cent of water cord
75	118.3	1.729	78.81	0.455	71.22	109.3	1.681	78.85	0.447	71.27
76	121.1	1.735	78.80	0.460	71.18	111.6	1.687	78.84	0.451	71.23
77	124.0	1.741	78.79	0.465	71.13	114.0	1.692	78.83	0.456	71.19
78	126.8	1.746	78.77	0.470	71.09	116.4	1.698	78.82	0.460	71.15
79	129.8	1.752	78.76	0.475	71.04	118.8	1.703	78.81	0.465	71.11
80	132.8	1.758	78.75	0.480	71.00	121.3	1.709	78.80	0.469	71.07
81	134.7	1.762	78.74	0.483	70.96	122.6	1.712	78.79	0.471	71.03
82	136.5	1.765	78.73	0.486	70.92	124.0	1.715	78.78	0.474	71.00
83	138.4	1.769	78.72	0.488	70.89	125.4	1.717	78.77	0.476	70.96
84	140.2	1.772	78.71	0.491	70.85	126.8	1.720	78.76	0.479	70.93
85	142.0	1.776	78.70	0.494	70.81	128.1	1.723	78.75	0.481	70.89
86	143.7	1.779	78.69	0.497	70.78	129.5	1.726	78.74	0.483	70.86
87	145.5	1.782	78.68	0.499	70.74	130.8	1.728	78.73	0.485	70.83
88	147.2	1.785	78.67	0.502	70.71	132.1	1.731	78.72	0.488	70.80
89	148.9	1.788	78.66	0.504	70.67	133.4	1.733	78.71	0.490	70.77
90	150.5	1.791	78.65	0.507	70.64	134.6	1.736	78.70	0.492	70.74
91	152.1	1.794	78.64	0.509	70.61	135.8	1.738	78.69	0.494	70.72
92	153.7	1.797	78.63	0.511	70.58	137.1	1.740	78.68	0.496	70.69
93	155.3	1.799	78.62	0.514	70.56	138.3	1.743	78.67	0.497	70.67
94	156.9	1.802	78.61	0.516	70.53	139.4	1.745	78.66	0.499	70.64
95	158.4	1.805	78.60	0.518	70.50	140.6	1.747	78.65	0.501	70.62
96	160.0	1.807	78.59	0.520	70.48	141.8	1.749	78.64	0.503	70.60
97	161.4	1.810	78.58	0.522	70.45	142.9	1.751	78.63	0.505	70.58
98	162.9	1.812	78.57	0.525	70.43	144.0	1.752	78.62	0.506	70.55
99	164.3	1.815	78.56	0.527	70.40	145.1	1.754	78.61	0.508	70.53
100	165.8	1.817	78.55	0.529	70.38	146.2	1.756	78.60	0.510	70.51
101	167.2	1.819	78.54	0.531	70.36	147.3	1.758	78.59	0.512	70.49
102	168.6	1.821	78.53	0.533	70.34	148.3	1.760	78.58	0.514	70.47
103	170.0	1.824	78.53	0.534	70.32	149.4	1.762	78.58	0.515	70.46
104	171.3	1.826	78.52	0.536	70.30	150.4	1.764	78.57	0.517	70.44
105	172.7	1.828	78.51	0.538	70.28	151.4	1.766	78.56	0.519	70.42
106	174.0	1.830	78.50	0.540	70.26	152.4	1.768	78.55	0.520	60.41
107	175.3	1.832	78.49	0.541	70.25	153.4	1.770	78.54	0.522	70.40
108	176.6	1.833	78.48	0.543	70.23	154.4	1.772	78.53	0.523	70.38
109	177.9	1.835	78.47	0.544	70.22	155.3	1.774	78.52	0.525	70.37
110	179.1	1.837	78.46	0.546	70.20	156.3	1.775	78.51	0.526	70.36
111	180.4	1.839	78.45	0.547	70.19	157.2	1.776	78.50	0.527	70.35
112	181.6	1.841	78.44	0.549	70.17	158.2	1.778	78.49	0.528	70.34

TABLE 74—Continued

AGE IN DAYS	MALES Body weight gms.	Brain weight gms.	Per cent of water brain	Cord weight gms.	Per cent of water cord	FEMALES Body weight gms.	Brain weight gms.	Per cent of water Brain	Cord weight gms.	Per cent of water cord
113	182.8	1.842	78.44	0.550	70.15	159.1	1.779	78.49	0.530	70.32
114	184.0	1.844	78.43	0.552	70.14	160.0	1.781	78.48	0.531	70.31
115	185.2	1.846	78.42	0.553	70.13	160.9	1.782	78.47	0.532	70.30
116	186.4	1.848	78.41	0.555	70.12	161.8	1.783	78.46	0.533	70.29
117	187.5	1.849	78.40	0.556	70.11	162.6	1.785	78.46	0.535	70.28
118	188.7	1.851	78.40	0.558	70.09	163.5	1.786	78.45	0.536	70.27
119	189.7	1.852	78.39	0.559	70.08	164.3	1.788	78.45	0.538	70.26
120	190.9	1.854	78.38	0.561	70.07	165.2	1.789	78.44	0.539	70.25
121	192.0	1.855	78.37	0.562	70.06	166.0	1.790	78.43	0.540	70.25
122	193.1	1.857	78.37	0.563	70.06	166.8	1.791	78.43	0.541	70.24
123	194.1	1.858	78.36	0.564	70.05	167.6	1.793	78.42	0.542	70.24
124	195.2	1.860	78.36	0.565	70.05	168.4	1.794	78.42	0.543	70.23
125	196.2	1.861	78.35	0.566	70.04	169.2	1.795	78.41	0.544	70.23
126	197.3	1.862	78.34	0.567	70.03	170.0	1.796	78.40	0.545	70.23
127	198.3	1.863	78.33	0.569	70.03	170.7	1.798	78.39	0.546	70.23
128	199.3	1.865	78.33	0.570	70.02	171.5	1.799	78.39	0.546	70.22
129	200.3	1.866	78.32	0.572	70.02	172.3	1.801	78.38	0.547	70.22
130	201.2	1.867	78.31	0.573	70.01	173.0	1.802	78.37	0.548	70.22
131	202.2	1.868	78.30	0.574	70.01	173.7	1.803	78.36	0.549	70.22
132	203.2	1.870	78.30	0.575	70.01	174.5	1.804	78.36	0.550	70.22
133	204.1	1.871	78.29	0.576	70.00	175.2	1.804	78.35	0.551	70.22
134	205.1	1.873	78.29	0.577	70.00	175.9	1.805	78.35	0.552	70.22
135	206.0	1.874	78.28	0.578	70.00	176.2	1.806	78.34	0.553	70.22
136	206.9	1.875	78.27	0.579	70.00	176.5	1.807	78.33	0.554	70.22
137	207.8	1.876	78.26	0.580	70.00	176.9	1.808	78.32	0.555	70.22
138	208.7	1.877	78.26	0.580	70.00	177.6	1.809	78.32	0.555	70.22
139	209.6	1.878	78.25	0.581	70.00	178.3	1.810	78.31	0.556	70.22
140	210.5	1.879	78.24	0.582	70.00	179.9	1.811	78.30	0.557	70.22
141	211.3	1.880	78.24	0.583	70.00	180.6	1.812	78.30	0.558	70.22
142	212.2	1.881	78.23	0.584	70.00	181.2	1.813	78.29	0.559	70.22
143	213.0	1.882	78.23	0.584	70.00	181.8	1.813	78.29	0.559	70.22
144	213.9	1.883	78.22	0.585	70.00	182.5	1.814	78.28	0.560	70.22
145	214.7	1.884	78.22	0.586	70.00	183.1	1.815	78.28	0.561	70.22
146	215.5	1.885	78.21	0.587	70.00	183.7	1.816	78.27	0.562	70.22
147	216.3	1.886	78.21	0.588	70.00	184.3	1.817	78.27	0.562	70.22
148	217.1	1.887	78.20	0.588	70.00	184.9	1.817	78.26	0.563	70.22
149	217.9	1.887	78.20	0.589	70.00	185.5	1.818	78.26	0.564	70.22
150	218.7	1.888	78.19	0.590	70.00	186.1	1.819	78.25	0.565	70.22

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weight *gms.*	Per cent of water cord
151	219.5	1.889	78.19	0.591	70.00	186.7	1.820	78.25	0.565	70.22
152	220.2	1.890	78.18	0.592	70.00	187.2	1.821	78.24	0.566	70.22
153	221.0	1.891	78.18	0.592	70.00	187.8	1.821	78.24	0.567	70.22
154	221.7	1.892	78.17	0.593	70.00	188.4	1.822	78.23	0.568	70.22
155	222.5	1.893	78.17	0.594	70.00	188.9	1.823	78.23	0.568	70.22
156	223.2	1.894	78.16	0.595	70.70	189.5	1.824	78.22	0.569	70.22
157	223.9	1.895	78.16	0.586	70.00	190.0	1.825	78.22	0.570	70.22
158	224.7	1.896	78.15	0.596	70.00	190.6	1.825	78.21	0.571	70.22
159	225.3	1.897	78.15	0.597	70.00	191.1	1.826	78.21	0.571	70.22
160	226.0	1.898	78.14	0.598	70.00	191.6	1.827	78.20	0.572	70.22
161	226.7	1.899	78.14	0.599	70.00	192.1	1.828	78.20	0.573	70.22
162	227.4	1.900	78.13	0.600	70.00	192.6	1.829	78.19	0.574	70.22
163	228.1	1.901	78.13	0.600	70.00	193.2	1.829	78.19	0.574	70.22
164	228.8	1.902	78.12	0.601	70.00	193.6	1.830	78.18	0.575	70.22
165	229.4	1.902	78.12	0.602	70.00	194.2	1.831	78.18	0.576	70.22
166	230.1	1.903	78.12	0.603	70.00	194.6	1.832	78.18	0.576	70.22
167	230.7	1.903	78.12	0.603	70.00	195.1	1.832	78.18	0.577	70.22
168	231.4	1.904	78.12	0.604	70.00	195.6	1.833	78.18	0.577	70.22
169	232.0	1.904	78.12	0.604	70.00	196.1	1.833	78.18	0.578	70.22
170	232.6	1.905	78.12	0.605	70.00	196.5	1.834	78.18	0.578	70.22
171	233.3	1.906	78.12	0.605	70.00	197.0	1.834	78.18	0.579	70.22
172	233.9	1.906	78.12	0.606	70.00	197.5	1.835	78.18	0.579	70.22
173	234.5	1.907	78.12	0.606	70.00	197.9	1.835	78.18	0.580	70.22
174	235.1	1.907	78.12	0.607	70.00	198.4	1.836	78.18	0.580	70.22
175	235.7	1.908	78.12	0.608	70.00	198.8	1.837	78.18	0.581	70.22
176	236.3	1.909	78.12	0.608	70.00	199.3	1.837	78.18	0.581	70.22
177	236.9	1.909	78.12	0.609	70.00	199.7	1.838	78.18	0.582	70.22
178	237.4	1.910	78.11	0.609	69.99	200.1	1.838	78.17	0.582	70.22
179	238.0	1.910	78.11	0.610	69.99	200.6	1.839	78.17	0.583	70.22
180	238.6	1.911	78.11	0.610	69.99	201.0	1.839	78.17	0.583	70.22
181	239.1	1.912	78.11	0.611	69.99	201.4	1.840	78.17	0.584	70.22
182	239.7	1.912	78.11	0.612	69.99	201.8	1.841	78.17	0.584	70.22
183	240.2	1.913	78.11	0.612	69.99	202.2	1.841	78.17	0.585	70.22
184	240.8	1.913	78.11	0.613	69.99	202.6	1.842	78.17	0.585	70.22
185	241.3	1.914	78.11	0.613	69.99	203.0	1.842	78.17	0.586	70.22
186	241.8	1.915	78.11	0.814	69.99	203.4	1.843	78.17	0.586	70.22
187	242.3	1.915	78.11	0.614	69.99	203.8	1.843	78.17	0.587	70.22
188	242.9	1.916	78.11	0.615	69.99	204.2	1.844	78.17	0.587	70.22

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weight *gms.*	Per cent of water cord
189	243.4	1.916	78.11	0.615	69.99	204.6	1.844	78.17	0.588	70.22
190	243.9	1.917	78.11	0.616	69.99	204.9	1.845	78.17	0.588	70.22
191	244.4	1.917	78.11	0.616	69.99	205.3	1.845	78.17	0.588	70.22
192	244.9	1.918	78.11	0.617	69.99	205.7	1.846	78.17	0.589	70.22
193	245.4	1.918	78.11	0.617	69.98	206.0	1.846	78.17	0.589	70.22
194	245.9	1.919	78.11	0.618	69.98	206.4	1.847	78.17	0.589	70.22
195	246.3	1.919	78.11	0.618	69.98	206.7	1.847	78.17	0.590	70.21
196	246.8	1.920	78.11	0.618	69.98	207.1	1.847	78.17	0.590	70.21
197	247.3	1.920	78.10	0.619	69.97	207.4	1.848	78.17	0.591	70.21
198	247.8	1.921	78.10	0.619	69.97	207.8	1.848	78.17	0.591	70.21
199	248.2	1.921	78.10	0.620	69.97	208.1	1.849	78.17	0.591	70.21
200	248.6	1.922	78.10	0.620	69.97	208.4	1.849	78.17	0.592	70.20
201	249.1	1.922	78.10	0.620	69.96	208.8	1.849	78.17	0.592	70.20
202	249.6	1.923	78.10	0.621	69.96	209.1	1.850	78.17	0.592	70.20
203	250.0	1.923	78.10	0.621	69.96	209.4	1.850	78.16	0.593	70.20
204	250.4	1.924	78.10	0.622	69.96	209.8	1.851	78.16	0.593	70.20
205	250.9	1.924	78.10	0.622	69.95	210.1	1.851	78.16	0.593	70.20
206	251.3	1.925	78.10	0.622	69.95	210.4	1.851	78.16	0.594	70.19
207	251.7	1.925	78.10	0.623	69.95	210.7	1.852	78.16	0.594	70.19
208	252.1	1.926	78.10	0.623	69.95	211.0	1.852	78.16	0.594	70.19
209	252.5	1.926	78.09	0.624	69.94	211.3	1.853	78.16	0.595	70.19
210	252.9	1.927	78.09	0.624	69.94	211.6	1.853	78.16	0.595	70.19
211	253.4	1.927	78.09	0.624	69.94	211.9	1.853	78.16	0.596	70.19
212	253.7	1.928	78.09	0.625	69.94	212.2	1.854	78.16	0.596	70.18
213	254.2	1.928	78.09	0.625	69.93	212.5	1.854	78.16	0.596	70.18
214	254.5	1.929	78.09	0.626	69.93	212.8	1.855	78.16	0.597	70.18
215	254.9	1.929	78.09	0.626	69.93	213.1	1.855	78.16	0.597	70.18
216	255.3	1.929	78.09	0.626	69.93	213.4	1.855	78.16	0.597	70.18
217	255.7	1.930	78.09	0.627	69.92	213.7	1.856	78.16	0.597	70.17
218	256.1	1.930	78.08	0.627	69.92	213.9	1.856	78.15	0.598	70.17
219	256.4	1.930	78.08	0.627	69.92	214.2	1.856	78.15	0.598	70.17
220	256.8	1.931	78.08	0.628	69.91	214.4	1.857	78.15	0.598	70.16
221	257.2	1.931	78.08	0.628	69.91	214.7	1.857	78.15	0.598	70.16
222	257.5	1.931	78.08	0.628	69.90	215.0	1.857	78.15	0.599	70.16
223	257.9	1.932	78.07	0.629	69.90	215.2	1.858	78.14	0.599	70.15
224	258.2	1.932	78.07	0.629	69.90	215.5	1.858	78.14	0.599	70.15
225	258.6	1.932	78.07	0.629	69.89	215.8	1.858	78.14	0.599	70.15
226	258.9	1.933	78.07	0.630	69.89	216.0	1.859	78.14	0.600	70.14

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weight *gms.*	Per cent of water cord
227	259.2	1.933	78.07	0.630	69.89	216.2	1.859	78.14	0.600	70.14
228	259.6	1.933	78.06	0.630	69.88	216.5	1.859	78.13	0.600	70.14
229	259.9	1.933	78.06	0.630	69.88	216.7	1.859	78.13	0.600	70.14
230	260.2	1.934	78.06	0.631	69.88	217.0	1.860	78.13	0.601	70.13
231	260.6	1.934	78.06	0.631	69.87	217.2	1.860	78.13	0.601	70.13
232	260.9	1.934	78.06	0.631	69.87	217.5	1.860	78.13	0.601	70.13
233	261.2	1.935	78.05	0.632	69.87	217.7	1.861	78.12	0.601	70.12
234	261.5	1.935	78.05	0.632	69.86	217.9	1.861	78.12	0.602	70.12
235	261.9	1.935	78.05	0.632	69.86	218.1	1.861	78.12	0.602	70.12
236	262.1	1.936	78.05	0.633	69.85	218.3	1.862	78.12	0.602	70.11
237	262.4	1.936	78.05	0.633	69.85	218.6	1.862	78.12	0.602	70.11
238	262.8	1.936	78.04	0.633	69.85	218.8	1.862	78.11	0.603	70.11
239	263.0	1.937	78.04	0.634	69.84	219.0	1.863	78.11	0.603	70.10
240	263.3	1.937	78.04	0.634	69.84	219.2	1.863	78.11	0.603	70.10
241	263.6	1.937	78.04	0.634	69.84	219.4	1.863	78.11	0.603	70.10
242	263.9	1.938	78.03	0.634	69.83	219.6	1.863	78.10	0.603	70.09
243	264.2	1.938	78.03	0.635	69.83	219.8	1.863	78.10	0.604	70.09
244	264.5	1.938	78.03	0.635	69.82	220.0	1.864	78.10	0.604	70.08
245	264.8	1.938	78.03	0.635	69.82	220.3	1.864	78.10	0.604	70.08
246	265.0	1.939	78.02	0.635	69.81	220.4	1.864	78.09	0.604	70.07
247	265.3	1.939	78.02	0.636	69.81	220.6	1.864	78.09	0.604	70.07
248	265.6	1.939	78.02	0.636	69.80	220.8	1.864	78.09	0.605	70.06
249	265.8	1.940	78.01	0.636	69.80	221.0	1.864	78.08	0.605	70.06
250	266.1	1.940	78.01	0.636	69.79	221.2	1.865	78.08	0.605	70.05
251	266.3	1.940	78.01	0.637	69.79	221.4	1.865	78.08	0.605	70.05
252	266.6	1.940	78.01	0.637	69.78	221.6	1.865	78.08	0.605	70.04
253	266.8	1.941	78.00	0.637	69.78	221.7	1.865	78.07	0.606	70.04
254	267.1	1.941	78.00	0.637	69.77	221.9	1.865	78.07	0.606	70.03
255	267.3	1.941	78.00	0.638	69.77	222.1	1.865	78.07	0.606	70.03
256	267.6	1.941	78.00	0.638	69.76	222.3	1.866	78.07	0.606	70.02
257	267.8	1.942	77.99	0.638	69.76	222.4	1.866	78.06	0.606	70.02
258	268.0	1.942	77.99	0.638	69.75	222.6	1.866	78.06	0.607	70.01
259	268.3	1.942	77.99	0.639	69.75	222.8	1.866	78.06	0.607	70.01
260	268.5	1.943	77.98	0.639	69.74	223.0	1.866	78.05	0.607	70.00
261	268.7	1.943	77.98	0.639	69.74	223.1	1.866	78.05	0.607	70.00
262	269.0	1.943	77.98	0.639	69.73	223.3	1.867	78.05	0.607	69.99
263	269.2	1.943	77.98	0.640	69.73	223.4	1.867	78.05	0.608	69.99
264	269.4	1.944	77.97	0.640	69.72	223.6	1.867	78.04	0.608	69.98

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weight *gms.*	Per cent of water cord
265	269.6	1.944	77.97	0.640	69.72	223.7	1.867	78.04	0.608	69.98
266	269.8	1.944	77.97	0.640	69.72	223.9	1.867	78.04	0.608	69.98
267	270.0	1.944	77.96	0.640	69.71	224.0	1.867	78.03	0.608	69.97
268	270.2	1.944	77.96	0.640	69.71	224.2	1.867	78.03	0.608	69.97
269	270.5	1.945	77.96	0.640	69.70	224.3	1.867	78.03	0.608	69.96
270	270.7	1.945	77.95	0.641	69.70	224.5	1.868	78.02	0.609	69.96
271	270.9	1.945	77.95	0.641	69.69	224.6	1.868	78.02	0.609	69.95
272	271.1	1.945	77.94	0.641	69.69	224.8	1.868	78.02	0.609	69.95
273	271.3	1.945	77.94	0.641	69.68	224.9	1.868	78.01	0.609	69.94
274	271.5	1.945	77.94	0.641	69.68	225.0	1.868	78.01	0.609	69.94
275	271.6	1.946	77.93	0.641	69.67	225.1	1.868	78.01	0.609	69.94
276	271.8	1.946	77.93	0.641	69.67	225.3	1.868	78.00	0.609	69.93
277	272.0	1.946	77.93	0.641	69.66	225.4	1.868	78.00	0.609	69.93
278	272.2	1.946	77.92	0.642	69.66	225.5	1.869	78.00	0.610	69.92
279	272.3	1.946	77.92	0.642	69.65	225.7	1.869	78.00	0.610	69.92
280	272.5	1.946	77.92	0.642	69.65	225.8	1.869	77.99	0.610	69.91
281	272.7	1.947	77.91	0.642	69.64	225.9	1.869	77.99	0.610	69.91
282	272.8	1.947	77.91	0.642	69.64	226.0	1.869	77.99	0.610	69.91
283	273.0	1.947	77.91	0.642	69.63	226.1	1.869	77.98	0.610	69.90
284	273.2	1.947	77.90	0.642	69.63	226.2	1.869	77.98	0.610	69.90
285	273.4	1.947	77.90	0.642	69.62	226.4	1.869	77.98	0.610	69.89
286	273.5	1.947	77.89	0.643	69.62	226.5	1.870	77.97	0.611	69.89
287	273.7	1.948	77.89	0.643	69.61	226.6	1.870	77.97	0.611	69.88
288	273.9	1.948	77.89	0.643	69.61	226.7	1.870	77.97	0.611	69.88
289	274.0	1.948	77.88	0.643	69.60	226.8	1.870	77.96	0.611	69.87
290	274.2	1.948	77.88	0.643	69.60	226.9	1.870	77.96	0.611	69.87
291	274.3	1.948	77.88	0.643	69.59	227.0	1.870	77.96	0.611	69.86
292	274.5	1.948	77.87	0.643	69.59	227.1	1.870	77.95	0.611	69.86
293	274.6	1.948	77.87	0.643	69.58	227.2	1.870	77.95	0.611	69.85
294	274.7	1.948	77.86	0.643	69.58	227.3	1.870	77.94	0.611	69.85
295	274.9	1.948	77.86	0.644	69.57	227.4	1.870	77.94	0.611	69.84
296	275.0	1.948	77.86	0.644	69.56	227.5	1.870	77.94	0.611	69.84
297	275.2	1.949	77.85	0.644	69.56	227.6	1.871	77.93	0.612	69.83
298	275.3	1.949	77.85	0.644	.69.55	227.7	1.871	77.93	0.612	69.83
299	275.4	1.949	77.84	0.644	69.55	227.8	1.871	77.92	0.612	69.82
300	275.5	1.949	77.84	0.644	69.54	227.9	1.871	77.92	0.612	69.82
301	275.7	1.949	77.84	0.644	69.53	228.0	1.871	77.92	0.612	69.81
302	275.8	1.949	77.83	0.644	69.53	228.0	1.871	77.91	0.612	68.81

TABLE 74—Continued

AGE IN DAYS	MALES					FEMALES				
	Body weight *gms.*	Brain weight *gms.*	Per cent of water brain	Cord weight *gms.*	Per cent of water cord	Body weight *gms.*	Brain weight *gms.*	Per cent of water Brain	Cord weight *gms.*	Per cent of water cord
303	275.9	1.949	77.83	0.645	69.52	228.1	1.871	77.91	0.612	69.80
304	276.1	1.949	77.82	0.645	69.52	228.2	1.871	77.90	0.612	69.80
305	276.2	1.949	77.82	0.645	69.51	228.3	1.871	77.90	0.612	69.79
306	276.3	1.949	77.82	0.645	69.50	228.3	1.871	77.90	0.612	69.79
307	276.4	1.949	77.81	0.645	69.50	228.4	1.871	77.89	0.612	69.78
308	276.5	1.949	77.81	0.645	69.49	228.5	1.871	77.89	0.612	69.78
309	276.6	1.950	77.80	0.645	69.49	228.6	1.872	77.88	0.613	69.77
310	276.7	1.950	77.80	0.645	69.48	228.7	1.872	77.88	0.613	69.77
311	276.9	1.950	77.80	0.646	69.47	228.7	1.872	77.88	0.613	69.76
312	277.0	1.950	77.79	0.646	69.47	228.8	1.872	77.87	0.613	69.76
313	277.0	1.950	77.79	0.646	69.46	228.8	1.872	77.87	0.613	69.75
314	277.1	1.950	77.78	0.646	69.46	228.9	1.872	77.86	0.613	69.75
315	277.2	1.950	77.78	0.646	69.45	229.0	1.872	77.86	0.613	69.74
316	277.3	1.950	77.77	0.646	69.44	229.0	1.872	77.85	0.613	69.73
317	277.5	1.950	77.77	0.646	69.44	229.1	1.872	77.85	0.613	69.73
318	277.5	1.950	77.76	0.646	69.43	229.1	1.872	77.84	0.613	69.72
319	277.6	1.950	77.76	0.646	69.43	229.2	1.872	77.84	0.613	69.72
320	277.7	1.950	77.75	0.646	69.42	229.3	1.872	77.83	0.613	69.71
321	277.8	1.950	77.75	0.646	69.41	229.3	1.872	77.83	0.613	69.71
322	277.9	1.951	77.74	0.647	69.41	229.4	1.873	77.82	0.614	69.70
323	278.0	1.951	77.74	0.647	69.40	229.4	1.873	77.82	0.614	69.70
324	278.0	1.951	77.73	0.647	69.40	229.5	1.873	77.81	0.614	69.69
325	278.1	1.951	77.73	0.647	69.39	229.5	1.873	77.81	0.614	69.68
326	278.2	1.951	77.72	0.647	69.38	229.6	1.873	77.80	0.614	69.68
327	278.3	1.951	77.72	0.647	69.38	229.6	1.873	77.80	0.614	69.67
328	278.4	1.951	77.71	0.647	69.37	229.7	1.873	77.79	0.614	69.67
329	278.4	1.951	77.71	0.647	69.37	229.7	1.873	77.79	0.614	69.66
330	278.5	1.951	77.70	0.647	69.36	229.8	1.873	77.78	0.614	69.66
331	278.6	1.951	77.70	0.647	69.35	229.8	1.873	77.78	0.614	69.65
332	278.6	1.951	77.69	0.647	69.35	229.8	1.873	77.77	0.614	69.64
333	278.7	1.951	77.69	0.647	69.34	229.9	1.873	77.77	0.614	69.64
334	278.7	1.952	77.68	0.648	69.34	229.9	1.874	77.76	0.615	69.63
335	278.8	1.952	77.68	0.648	69.33	229.9	1.874	77.76	0.615	69.63
336	278.9	1.952	77.67	0.648	69.32	230.0	1.874	77.75	0.615	69.62
337	278.9	1.952	77.67	0.648	69.32	230.0	1.874	77.75	0.615	69.62
338	279.0	1.952	77.66	0.648	69.31	230.0	1.874	77.74	0.615	69.61
339	279.0	1.952	77.66	0.648	69.31	230.1	1.874	77.74	0.615	69.61
340	279.1	1.952	77.65	0.648	69.30	230.1	1.874	77.73	0.615	69.60

TABLE 74—Concluded

AGE IN DAYS	MALES					FEMALES				
	Body weight gms.	Brain weight gms.	Per cent of water brain	Cord weight gms.	Per cent of water cord	Body weight gms.	Brain weight gms.	Per cent of water brain	Cord weight gms.	Per cent of water cord
341	279.2	1.952	77.64	0.648	69.29	230.1	1.874	77.72	0.615	69.59
342	279.2	1.952	77.64	0.648	69.29	230.1	1.874	77.72	0.615	69.59
343	279.3	1.952	77.63	0.648	69.28	230.2	1.874	77.71	0.615	69.58
344	279.3	1.952	77.63	0.648	69.27	230.2	1.874	77.71	0.615	69.57
345	279.3	1.952	77.62	0.648	69.27	230.2	1.874	77.70	0.615	69.57
346	279.4	1.952	77.61	0.648	69.26	230.3	1.874	77.69	0.615	69.56
347	279.4	1.953	77.61	0.648	69.25	230.3	1.874	77.69	0.615	69.56
348	279.5	1.953	77.60	0.648	69.25	230.3	1.874	77.68	0.615	69.55
349	279.5	1.953	77.60	0.648	69.24	230.3	1.874	77.68	0.615	69.54
350	279.6	1.953	77.59	0.648	69.23	230.3	1.874	77.67	0.615	69.54
351	279.6	1.953	67.58	0.648	69.23	230.3	1.874	77.66	0.615	69.53
352	279.6	1.953	77.58	0.648	69.22	230.3	1.874	77.66	0.615	69.52
353	279.7	1.953	77.57	0.649	69.21	230.4	1.875	77.65	0.616	69.52
354	279.7	1.953	77.57	0.649	69.20	230.4	1.875	77.65	0.616	69.51
355	279.7	1.953	77.56	0.649	69.20	230.4	1.875	77.64	0.616	69.50
356	279.8	1.953	77.55	0.649	69.19	230.4	1.875	77.63	0.616	69.50
357	279.8	1.953	77.55	0.649	69.18	230.4	1.875	77.63	0.616	69.49
358	279.8	1.953	77.54	0.649	69.18	230.4	1.875	77.62	0.616	69.48
359	279.8	1.954	77.54	0.649	69.17	230.4	1.875	77.62	0.616	69.48
360	279.8	1.954	77.53	0.649	69.16	230.4	1.875	77.61	0.616	69.47
361	279.8	1.954	77.52	0.649	69.16	230.4	1.875	77.60	0.616	69.47
362	279.9	1.954	77.52	0.649	69.15	230.4	1.875	77.60	0.616	69.46
363	279.9	1.954	77.51	0.649	69.14	230.4	1.875	77.59	0.616	69.45
364	279.9	1.954	77.51	0.649	69.14	230.4	1.875	77.59	0.616	69.45
365	279.9	1.954	77.50	0.649	69.13	230.4	1.875	77.58	0.616	69.44

12. *Formulas.* Formulas for computing the length or weight of the body and of its several parts, systems or organs, also for expressing the values of other characters.

The formulas for the Albino—Group I— are given first, then those for the Norway—Group II. In Group I there are two divisions. The first division comprises the formulas based on size (body length and body weight). The second division comprises the formulas based on age. These formulas have been kept simple in order to facilitate their use. This condition has made it sometimes necessary to have different formulas for the different parts of the same series of data, but this was deemed more desirable than a reduction in the number of the formulas at the price of greater complexity.

After the formula there follows in parenthesis the number by which it is designated in the text, and every formula, whether it be general or subsidiary, is thus numbered, each subsidiary formula carrying the number of the general formula to which it is related, followed by a distinguishing letter. A catalog of the formulas, given in detail later, is here presented.

CATALOG OF FORMULAS

GROUP I. ALBINOS

First division: Formulas based on size

Body length on body weight (1).
Body weight on body length (2), (2 a), (2 b).
Body weight on brain weight (3).
Tail length on body length (4), (5).
Brain weight on body weight (6), (7).
Cranial capacity on body weight (8), (9), (10).
Spinal cord weight on body weight (11).
Diameters of ganglion cell and nucleus (12), (12 a).
Weight of both eyeballs on body weight (13).
Weight of heart on body weight (14).
Weight of both kidneys on body weight (15).
Weight of liver on body weight (16).
Weight of spleen on body weight (17).
Weight of both lungs on body weight (18).
Volume of blood on body weight (19), (19 a), (19 b).
Weight of blood on body weight (20), (20 a), (20 b).
Weight of alimentary tract on body weight (21).

Weight of both testes on body weight (22), (23), (24).
Weight of both ovaries on body weight (25), (26), (27).
Weight of hypophysis on body weight (28), (29).
Weight of both suprarenals on body weight (30), (31).
Weight of thyroid on body weight (32).
Weight of nitrogen on body weight (33).

Second division: Formulas based on age in days

Body weight on age (34), (35), (36), (37).
Weight of thymus on age (38), (39).
Percentage of water in brain—on age (40), (41), (42), (42 a).
Percentage of water in spinal cord—on age (43), (44), (45), (45 a), (45 b), (45 c), (45 d).

GROUP II. NORWAYS

First division: Formulas based on size

Body length on body weight (46).
Body weight on body length (47), (48).
Body weight Norway on body weight Albino (49).
Tail length on body length (50), (51).
Brain weight on body weight (52).
Cranial capacity on body weight (53).
Spinal cord weight on body weight (54).
Spinal cord weight on brain weight (55).

GROUP I. ALBINOS

FIRST DIVISION: FORMULAS BASED ON SIZE

Body Length on Body Weight, (Donaldson, '09)

$$\textit{Body length (sexes combined)} = 143 \log (Bd.wt. + 15) - 134 \quad (1)$$

A study of tables 1 and 2 in the investigations by Donaldson '09 shows that for a given body weight the body length of the male is about 2.2 per cent greater than that of the female. If then the value found by this formula for any body weight is increased by 1.1 per cent of itself the sum obtained represents the body length for the male. If on the contrary, the value found is decreased by 1.1 per cent of itself, the difference obtained represents the body length for the corresponding female.

BODY WEIGHT ON BODY LENGTH (DONALDSON, '09)

By transposing formula (1) we obtain

$$\textit{Body weight (sexes combined)} = 10^{\frac{Bd.\,l. + 134}{143}} - 15 \qquad (2)$$

As the body length for a given body weight is for the male 1.1 per cent above the value in (2) and for the female 1.1 per cent below the value in (2), two new formulas have been made for the male and female respectively—thus

$$\textit{Body weight:—male} = 10^{\frac{(100\,Bd.\,l. - 1.1\,Bd.\,l.) + 13400}{14300}} - 15 \qquad (2a)$$

$$\textit{Body weight:—female} = 10^{\frac{(100\,Bd.\,l. + 1.1\,Bd.\,l.) + 13400}{14300}} - 15 \qquad (2b)$$

By use of formulas (2a) and (2b) the body weights corresponding to body lengths from 50–250 mm have been computed for each sex and the values obtained are those entered in the accompanying tables.

To illustrate the procedure with a formula of this sort the following example is given.

To compute the body weight for a body length of 150 mm. (male) by the following formula (2a).

$$\textit{Body weight (male)} = 10^{\frac{(100\,Bd.\,l. - 1.1\,Bd.\,l.) + 13400}{14300}} - 15$$

Transpose 15 from right hand side to the left and take the logarithm of both sides. We have

$$\log\,(Bd.\,wt. + 15) = \log 10 \times \frac{(100 \times 150 - 1.1 \times 150) + 13400}{14300}$$

$$1 \times \frac{15000 - 165 + 13400}{14300} = 1.9745$$

Thus 1.9745 is equivalent to the logarithm of body weight plus 15. Therefore body weight + 15 = 94.3 (anti-logarithm of 1.9745). Finally, body weight = 94.3 − 15 = 79.3 grams.

The above procedure is that to be followed with other formulas of the same type.

Body Weight on Brain Weight (Donaldson, '08)

$$\textit{Body weight (sexes combined)} = 8.7 + 10^{\frac{Br.\,wt. - 0.554}{0.569}} \tag{3}$$

Tail Length on Body Length. (Hatai, ms '14.)

$$\textit{Tail length: male} = 0.852\,Bd.\,l. + 38.8\,(\log Bd.\,l.) - 90.5 \tag{4}$$

$$\textit{Tail length:—female} = 0.874\,Bd.\,l. + 43.2\,(\log Bd.\,l) - 98.1 \tag{5}$$

Formulas (4) and (5) were used for table 68.

BRAIN WEIGHT ON BODY WEIGHT. (HATAI, '09, p. 172)

For the brain weight of sexes combined, the following formulas have been obtained:—

$$\textit{Brain weight (sexes combined)} = 1.56 \log (\textit{Bd. wt.}) - 0.87 \qquad (6)$$
$$[5 < \textit{Bd. wt.} < 10 \textit{ gms.}]$$

$$\textit{Brain weight (sexes combined)} = 0.569 \log (\textit{Bd. wt.} - 8.7) + .554 \qquad (7)$$
$$[\textit{Bd. wt.} > 10 \textit{ gms.}]$$

For a given body weight the average brain weight in the male was found to be 1.5 per cent more than in the female, hence the determinations of brain weight on body weight by formulas (6) and (7) give final values which must be increased by 0.75 per cent to represent the male brain and decreased by 0.75 per cent to represent the female brain weight. By using this procedure the data on brain weight given in table 68 were obtained.

CRANIAL CAPACITY ON BODY WEIGHT. (HATAI, '07 c)

Cranial capacity represented by the weight of the shot contained is given by

$$\textit{Cranial capacity (shot wt.)} = 0.0072 \times (\textit{Bd. wt. male}) + 9.349 \qquad (8)$$

To reduce the shot weight to brain weight in the male, the value obtained is to be divided by 5.98.

The corresponding formula for the female is

$$\textit{Cranial capacity (shot wt.)} = 0.0251 \times (\textit{Bd. wt. female}) + 6.168 \qquad (9)$$

To reduce the shot weight to brain weight in the female, the value obtained is to be divided by 6.009.

For the cranial capacity expressed in cc. Donaldson ('12), the formula for sexes combined is

Cranial capacity in cc. =

$$1.02\ log\ Bd.\ wt. - 0.00027\ Bd.\ wt. - 0.596 \qquad (10)$$

$$[80 < Bd.\ wt. < 300]$$

Spinal Cord Weight on Body Weight (Donaldson, '09)

Spinal cord wt. (sexes combined) =

$$0.585 \log (Bd.\ wt. + 21) - 0.795 \qquad (11)$$

In the female the spinal cord is about 2 per cent heavier than in the male, therefore when using formula (11) the values obtained require to be increased by 1 per cent to represent the weight of the spinal cord in the female and to be diminished by 1 per cent to represent its weight in the male. By using this procedure, the data on the weights of the spinal cord in table 68 have been obtained.

Diameter of Second Cervical Spinal Ganglion Cell Nucleus on Diameter of Cell Body (Hatai, '07b)

Correlation between diameter of cell body and diameter of nucleus in μ – in spinal ganglion cells of second cervical nerve.

Diameter of nucleus in μ =

$$12.2939 \left\{ 1.0252 + 0.3564\left(\frac{x}{l}\right) - 0.0758 \left(\frac{x}{l}\right)^2 \right\} \qquad (12)$$

where x is the diameterof the cell in μ and l is a half range of the variates.

As the value of l is 10, the formula (12) may be transformed by a series of steps here omitted, to read

$$D\,n = 12.6 + 4.3\left\{\frac{D\,c\,b - 29}{20}\right\} - 0.9\left\{\frac{D\,c\,b - 29}{20}\right\}^2 \quad (12a)$$

Where D n = Diameter of nucleus in μ
and D c b = Diameter of cell body in μ.

See table 31.

WEIGHT OF BOTH EYEBALLS ON BODY WEIGHT. (HATAI, '13, p. 112)

Weight of both eyeballs (sexes combined) =

$$0.000428\ Bd.\ wt. + 0.098\ log\ Bd.\ wt. - 0.041 \quad (13)$$

Formula (13) was used for table 68.

WEIGHT OF HEART ON BODY WEIGHT (HATAI, '13)

Weight of heart (sexes combined) =

$$0.0026\ (Bd.\ wt. + 14) + 0.249\ log\ (Bd.\ wt. + 14) - 0.336 \quad (14)$$

Formula (14) was used for table 69.

WEIGHT OF BOTH KIDNEYS ON BODY WEIGHT (HATAI, '13)

Weight of both kidneys (sexes combined) =

$$0.00718\ (Bd.\ wt. - 3) + 0.132\ log\ (Bd.\ wt. - 3) - 0.009 \quad (15)$$

Formula (15) was used for table 69.

WEIGHT OF LIVER ON BODY WEIGHT (HATAI, '13)

Weight of liver (sexes combined) =

$$0.0303\ (Bd.\ wt. + 5) + 3.340\ log\ (Bd.\ wt. + 5) - 3.896 \quad (16)$$

$$[Bd.\ wt. > 10]$$

Formula (16) was used for obtaining the values given in table 69 for body weights of 10 grams or above. For body weights below 10 grams the weights have been determined by graphic interpolation—using the crude records as a basis.

WEIGHT OF SPLEEN ON BODY WEIGHT (HATAI, '13)

Weight of spleen (sexes combined) =

$$0.00245\ Bd.\ wt. + 0.0301\ log\ (Bd.\ wt.) - 0.025 \quad (17)$$

Formula (17) was used for table 69.

WEIGHT OF BOTH LUNGS ON BODY WEIGHT (HATAI, '13)

Weight of both lungs (sexes combined) =

$$0.00471\ (Bd.\ wt. + 2) + 0.122\ log\ (Bd.\ wt. + 2) - 0.056 \quad (18)$$

Formula (18) was used for table 70.

VOLUME OF THE BLOOD ON BODY WEIGHT (CHISOLM, '11) AND HATAI (MS '14)

$$Blood\ volume\ (sexes\ combined) = \frac{Bd.\ wt.^{0.9}}{10.1} = 0.099\ Bd.\ wt.^{0.9} \quad (19)$$

$$[5 < Bd.\ wt. < 150]$$

Blood volume (males) =

$$0.099\ Bd.\ wt.^{0.9} - .03\ (.099\ Bd.\ wt.)^{0.9} \quad (19a)$$

$$= 0.09603\ Bd.\ wt.^{0.9}$$

$$[150 < Bd.\ wt. < 350]$$

Blood volumes (females) =

$$0.099\ Bd.\ wt.^{0.9} + .06\ (.099\ Bd.\ wt.)^{0.9} \qquad (19b)$$

$$= 0.10494\ Bd.\ wt.^{0.9}$$

$$[150 < Bd.\ wt. < 350]$$

By using the factor 1.056 for the specific gravity of the blood corresponding formulas for the *blood weight on body weight* have been obtained as follows: Hatai (MS '14).

Blood weight (sexes combined) =

$$0.099\ Bd.\ wt.^{0.9} \times 1.056\ or = 0.1045\ Bd.\ wt.^{0.9} \qquad (20)$$

$$[5 < Bd.\ wt. < 150]$$

Blood weight (males) =

$$0.1045\ Bd.\ wt.^{0.9} - .03\ (0.1045\ Bd.\ wt.)^{0.9} \qquad (20a)$$

$$= 0.101365\ Bd.\ wt.^{0.9}$$

$$[150 < Bd.\ wt. < 350]$$

Blood weight (females) =

$$0.1045\ Bd.\ wt.^{0.9} + 0.06\ (0.1045\ Bd.\ wt.^{0.9}) \qquad (20b)$$

$$= 0.11077\ Bd.\ wt.^{0.9}$$

$$(150 < Bd.\ wt. < 350)$$

These formulas (20), (20 a) and (20 b) for blood weight have been used for table 70.

WEIGHT OF ALIMENTARY TRACT ON BODY WEIGHT (HATAI, '13)

$$\textit{Weight of alimentary tract (sexes combined)} = 0.0245\,Bd.\,wt. + 4.720\,log\,(Bd.\,wt. + 7) - 5.753 \quad (21)$$

Formula (21) was used for table 70.

WEIGHT OF BOTH TESTES ON BODY WEIGHT (HATAI, '13)

$$Wt.\ of\ testes = 0.022 - 0.00992\ Bd.\ wt. + 0.00127\ Bd.\ wt.^2 \quad (22)$$
$$[4 < Bd.\ wt. < 10]$$
$$= 0.043 - 0.000966\ Bd.\ wt. + 0.000163\ Bd.\ wt.^2 \quad (23)$$
$$[10 < Bd.\ wt. < 80]$$
$$= 2.910\ log\ Bd.\ wt. - 4.520 \quad (24)$$
$$[Bd.\ wt. > 80]$$

For the weight of the testes for body weights of 4–10 grams, the values were obtained by formula (22), while formulas (23) and (24) were used for obtaining the values for body weights of 10 grams or over. Formulas (22) (23) and (24) were used for table 70.

WEIGHT OF BOTH OVARIES ON BODY WEIGHT (HATAI, '13)

$$Weight\ of\ both\ ovaries =$$
$$= 0.00781\ log.\ Bd.\ wt. - 0.0047 \quad (25)$$
(*Phase* 1) $[Bd.\ wt. < 65]$
$$= 0.0425 - 0.00121\ Bd.\ wt. + 0.0000108\ Bd.\ wt.^2 \quad (26)$$
(*Phase* 2) $[65 < Bd.\ wt. < 110]$
$$= 0.007\ log.\ (Bd.\ wt. - 105) + 0.0352 \quad (27)$$
(*Phase* 3) $[Bd.\ wt. > 110]$

Formulas (25) (26) (27) were used for table 70.

WEIGHT OF HYPOPHYSIS ON BODY WEIGHT (HATAI, '13)

In the case of the hypophysis a separate formula for each sex is required.

Weight of hypophysis (male) =

$$0.0000257\ (Bd.\ wt. + 3) + 0.0014\ log\ (Bd.\ wt. + 3) - 0.00097 \quad (28)$$

Formula (28) is also used for the female up to 50 gms. in body weight then

Weight of hypophysis (female) =

$$0.00205 + 0.000081\ Bd.\ wt. - 0.00196\ log\ (Bd.\ wt.) \quad (29)$$

$$[Bd.\ wt. > 50]$$

Formulas (28) and (29) were used for table 71 in accordance with the restrictions indicated.

WEIGHT OF BOTH SUPRARENALS ON BODY WEIGHT (HATAI, '13)

In the case of the suprarenals a separate formula for each sex is required.

Weight of both suprarenals (male) =

$$0.0000855\ (Bd.\ wt. + 3) + 0.0113\ log\ (Bd.\ wt. + 3) - 0.0093 \quad (30)$$

Formula (30) is also used for the female up to 30 gms. in body weight, then

Weight of both suprarenals (female) =

$$0.00023\ Bd.\ wt. + 0.00388\ log\ (Bd.\ wt.) - 0.002 \quad (31)$$

$$[Bd.\ wt. > 30]$$

Formulas (30) and (31) were used for table 71 in accordance with the restrictions indicated.

Weight of Thyroid on Body Weight (Hatai, '13)

Weight of thyroid (sexes combined) =

$$0.0000973\ (Bd.\ wt. + 27) + 0.0139\ log\ (Bd.\ wt. + 27) - 0.0226 \quad (32)$$

Formula (32) was used for table 71.

Weight of Nitrogen on Body Weight (Hatai, '05)

To determine the amount of nitrogen eliminated by the rat during twenty-four hours at different body weights. Ration: Uneeda biscuit and water only—Chicago colony.

$$N = 10^{\frac{233 + (3 \times log\ Bd.\ wt.)}{4}}\ or\ log\ N = \frac{233 + (3 \times log\ Bd.\ wt.)}{4} \quad (33)$$

where N = total nitrogen in milligrams and Bd. wt. = body weight in grams.

Formula 33 is based on the data in table 42.

GROUP I. ALBINOS

SECOND DIVISION: FORMULAS BASED ON AGE

Body Weight on Age from 10–365 Days, Hatai (ms '14)

The formulas (34) (35) (36) (37) apply only to the series of data published by Donaldson, Dunn and Watson, ('06.)

Body weight on age in days—males =

$$11.199 + 0.0475\ Age + 0.0184\ Age^2 \quad (34)$$
$$[10 < Age < 80]$$

$$= 448\ log\ Age - 0.52\ Age - 678.2 \quad (35)$$
$$[80 < Age < 365]$$

Body weight on age in days—mated females =

$$8.071 + 0.367\, age + 0.0131\, Age^2 \quad (36)$$
$$[10 < Age < 80]$$

$$= 343\, log\, Age - 0.41\, Age - 498.8 \quad (37)$$
$$[80 < Age < 365]$$

Formulas (34) (35) (36) (37) were used for table 62.

WEIGHT OF THYMUS ON AGE (HATAI, '14)

Weight of thymus—sexes combined =

$$0.01 \times 10^{1.1\left\{1.1884+0.5665\left(\frac{age}{55}-1\right)-0.5651\left(\frac{age}{55}-1\right)^2\right\}} \quad (38)$$
$$[Age < 95]$$

Weight of thymus =

$$0.3903 - 0.00139\,(age) + 0.00000128\,(age)^2 \quad (39)$$
$$[Age > 95]$$

Formulas (38) (39) were used for table 72.

PERCENTAGE OF WATER IN BRAIN. HATAI (MS '14)

The formulas do not apply to rats under ten days of age.

Percentage of water in brain—(male) =

$$92.122 - 0.614\, Age + 0.00739\, Age^2\ (Phase\ 1) \quad (40)$$
$$[10 < Age < 40]$$

$$= 82.756 - 2.103\, log\, Age \qquad (Phase\ 2) \quad (41)$$
$$[40 < Age < 160]$$

$$= 77.671 + 0.00537\, Age - 0.000016\, Age^2\ (Phase\ 3) \quad (42)$$
$$[160 < Age < 365]$$

To transform any determination for the male into that for the female, the value for the male at a given age (see formulas (40) (41), (42)) is modified by a *plus* correction (Hatai).

$$\textit{Correction (plus)} = 0.0555 \log (age + 3) - 0.0606 \qquad (42a)$$

$$[10 < Age < 365]$$

The foregoing (40)-(42a) replace the formulas given in the paper by Donaldson ('10).

Formulas (40) (41) (42) (42a) were used for table 74.

PERCENTAGE OF WATER IN SPINAL CORD—(HATAI MS '14)

The formulas do not apply under 10 days of age. The data for the first ten days are from direct observations.

Percentage of water in spinal cord—male =

$$87.976 - 0.494\ Age + 0.00364\ Age^2\ (\textit{Phase}\ 1) \qquad (43)$$

$$[10 < Age < 40]$$

$$= 100.3 + 0.0548\ Age - 17.7 \log Age\ \ (\textit{Phase}\ 2) \qquad (44)$$

$$[40 < Age < 150]$$

$$= 62.186 - 0.0121\ Age + 4.434 \log Age\ \ (\textit{Phase}\ 3) \qquad (45)$$

$$[150 < Age < 365]$$

To obtain from the values for the male at different ages the corresponding value for the female, several corrections are required and these differ according to age.

From ten to fifty days the following correction formula (45a) is used:

$$\textit{Correction (minus)} = 0.0006\ Age^2 - 0.036\ Age + 0.3 \qquad (45a)$$

The values thus obtained are subtracted from the computed values for the male at the corresponding ages.

From fifty to sixty-five days no correction is made.

From sixty-five days to one hundred and thirty-five days, correction is made according to the formula (45b)

$$Correction\ (plus) = 0.823\ log\ (Age+1) - 0.000542\,(Age+1) - 1.4616 \tag{45b}$$

From one hundred and thirty-five to one hundred and sixty-five days the correction is uniform thus:

$$Correction\ (plus) = 0.22 \tag{45c}$$

From one hundred and sixty-five to three hundred and sixty-five days correction is made by the following formula:

$$Correction\ (plus) = 0.22 + 0.0005\ (Age - 165) \tag{45d}$$

The foregoing (43)-(45d) replace the formulas given in the paper by Donaldson, '10.

Formulas (43)-(45d) were used for table 74.

GROUP II. NORWAYS

FIRST DIVISION: FORMULAS BASED ON SIZE

Body Length on Body Weight—Norway (Donaldson and Hatai, '11)

$$Body\ length\ (sexes\ combined) = 159\ log\ (Bd.\ wt. + 18) - 165 \tag{46}$$

The body length for the male is 0.4 per cent above the value given by formula (46) and that for the female 0.4 per cent below. Formula (46) with above corrections was used for graphs in chart 28.

BODY WEIGHT ON BODY LENGTH (DONALDSON AND HATAI, (11)

By transforming formula (46) and introducing the correction for sex we obtain

(1) For the male

$$Body\ weight = 10^{0.0000629\,(Bd.\,l. \times 100 - [(Bd.\,l. \times 100) \times 0.004] + 16500)} - 18 \quad (47)$$

$$= 10^{0.0000629\,(Bd.\,l. \times 99.6 + 16500)} - 18$$

(2) For the female

$$Body\ weight = 10^{0.0000629\,(Bd.\,l. \times 100 + [(Bd.\,l. \times 100) \times 0.004] + 16500)} - 18 \quad (48)$$

$$= 10^{0.0000629\,(Bd.\,l. \times 100.4 + 16500)} - 18$$

Formulas (47) (48) were used for table 85.

BODY WEIGHT OF NORWAY ON BODY WEIGHT OF ALBINO (MALES) (DONALDSON AND HATAI, '11, P. 442)

$$Body\ weight\ (Norway) =$$

$$137.1 - 0.636\ Bd.\,wt.\,Albino + 0.00643\ Bd.\,wt.\,Albino^2 \quad (49)$$

$$[160 < Bd.\,wt.\,Albino < 300]$$

TAIL LENGTH ON BODY LENGTH NORWAY (HATAI, MS '14)

(1) For the male

$$Tail\ length = 0.824\ Bd.\,l. + 39.1\ (log.\ Bd.\,l.) - 92.6 \quad (50)$$

(2) For the female

$$\textit{Tail length} = 0.824\ \textit{Bd. l.} + 43.1\ \textit{log}\ (\textit{Bd. l.}) - 98.4 \qquad (51)$$

Formulas (50) (51) were used for table 85.

Brain Weight on Body Weight, Norway (Donaldson and Hatai, '11)

$$\textit{Brain weight (sexes combined)} = 0.825\ \textit{log}\ (\textit{Bd. wt.} - 4) + 0.233 \qquad (52)$$

This formula applies only to rats 5 grams or more in body weight. To obtain the weights for the male the values given by the formula are increased by 1 per cent, and to obtain the weights for the female, they are decreased by 1 per cent.

Formula (52) with corrections mentioned above used for table 85.

Cranial Capacity on Body Weight, Norway (Donaldson, '12)

$$\textit{Cranial capacity in cc. (sexes combined)} =$$
$$0.00105\ \textit{Bd. wt.} + 0.548\ \textit{log Bd. wt.} + 0.476 \qquad (53)$$
$$[80 < \textit{Bd. wt.} < 380]$$

Spinal Cord Weight on Body Weight, Norway (Donaldson and Hatai, '11)

$$\textit{Spinal cord weight (sexes combined)} =$$
$$0.724\ \textit{log}\ (\textit{Bd. wt.} + 30) - 1.082 \qquad (54)$$

To obtain the weights for the male the values given by the formula are increased by 0.15 per cent, and to obtain the weights for the female they are decreased by 0.15 per cent.

Formula (54) with corrections mentioned above was used for table 85.

Spinal Cord Weight on Brain Weight (Sexes Combined) Norway (Donaldson and Hatai, '11)

$$Spinal\ cord\ wt. = 0.724\ log\ (10^{\frac{Br.\,wt.\,-\,0.233}{0.825}} + 34) - 1.082 \qquad (55)$$

For the Norway we have no extensive data based on age—hence there are no formulas based on age.

GROWTH OF PARTS AND ORGANS: REFERENCES

Chisolm, '11. Donaldson, '06, '08, '09, '11, '11 c, '12. Donaldson and Hatai, '11. Ferry, '13. Hatai, '03 a, '04 a, '07 a, '08, '13, '13 a, '14, '14 a. Jackson and Lowrey, '12. Jackson, '13. Jolly and Stini, '05. Watson, '05.

12. *Formulas*. Chisolm, '11. Donaldson, '08, '09, '12. Donaldson and Hatai, '11. Hatai, '05, '07 b, '07 c, '09 a, '10, '10 a, '11, '14.

CHAPTER 8

GROWTH IN TERMS OF WATER AND SOLIDS

1. In the body as a whole. 2. In the larger divisions of the body and the organs. 3. In the brain and spinal cord.

Water and solids 1) *in the body as a whole and* 2) *in the larger divisions and the organs.* Data on this head have been published by Lowrey ('13) and are here presented.

With the exception of one of the old rats the animals used for the following table 75 were reared at the University of Missouri. They were fed on chopped corn with a daily ration of bread soaked in whole milk and once a week a small quantity of fresh beef was given them. All were sound except some of the older animals which suffered from infected lungs—but not to such a degree as to affect their general nutrition or vigor. Table 75 is based on table 1, Lowrey ('13). The data for the two sexes are combined. In the original the range of the observations is given and also the number of animals used in each instance. In the present table the ranges are omitted and the number of animals is given for the body weight (net) only. The other determinations for the systems and organs were based on about the same number of animals as were used for the body weight, except in the case of the testes where the numbers are about half as large. The oldest animals were somewhat under one year of age. 3) *Percentage of water in the brain and spinal cord.* Using stock rats from the colony at The Wistar Institute, the percentage of water has been determined for the brain and spinal cord by Donaldson (MS '14). The values obtained by this study replace those previously published. (Donaldson '10.) The methods of removal are given on page 90. The rats were reared on a scrap diet. The fresh brain or cord was weighed in a closed bottle, then dried at 90°–95°C. until the dried weight was constant—and the difference taken as the amount of water.

TABLE 75

Percentages of dry substance in the entire body—in several of the systems and in some organs. Observations at seven ages. See chart 24

AGE IN DAYS	BODY (NET)			INTEGUMENTS		LIGAMENTOUS SKELETON		MUSCULATURE	
	No. of animals	Av. fresh weight	Av. % of dry subs.	Av. fresh weight	Av. % of dry subs.	Av. fresh weight	Av. % of dry subs.	Av. fresh weight	Av. % of dry subs.
		gms.		*gms.*		*gms.*		*gms.*	
0.....	15	4.200	11.7	0.880	12.3	0.660	18.1	1.100	10.7
7.....	10	9.100	20.1	2.180	23.4	1.710	22.1	2.020	16.2
20.....	9	24.500	29.9	5.020	41.1	4.090	33.3	6.400	22.6
42.....	10	61.300	29.5	11.040	37.1	8.610	39.2	18.730	23.5
70.....	7	126.700	33.0	20.020	43.0	14.840	45.9	51.500	25.2
150.....	10	182.400	32.2	32.200	44.2	20.020	50.4	76.920	24.3
365 (?)..	2	267.500	31.5	37.780	45.5	23.180	52.6	125.000	23.8
		ALL VISCERA		EYEBALLS		HEART		LUNGS	
0.....		0.780	15.2	0.023	7.4	0.025	13.8	0.077	15.9
7.....		1.760	14.2	0.066	10.4	0.061	14.4	0.169	15.8
20.....		5.090	19.1	0.110	14.4	0.135	18.0	0.236	18.9
42.....		12.170	20.7	0.162	15.3	0.412	21.0	0.404	19.1
70.....		20.900	24.4	0.207	17.0	0.625	21.6	0.791	19.2
150.....		26.570	25.6	0.279	19.0	0.714	21.2	1.354	19.0
365 (?)..		31.750	25.1	0.340	20.2	0.934	22.4	2.806	18.4
		LIVER		SPLEEN		KIDNEYS		TESTES	
0.....		0.234	19.4			0.038	13.3		
7.....		0.307	20.6	0.041	14.3	0.123	14.5		
20.....		1.200	24.3	0.076	17.2	0.322	17.2	0.106	12.9
42.....		3.541	24.2	0.273	19.8	0.832	20.3	0.568	13.3
70.....		6.617	25.5	0.588	20.1	1.320	20.8	1.653	12.4
150.....		9.236	25.7	0.666	20.6	1.728	21.0	2.425	12.2
365 (?)..		9.959	26.0	0.722	22.6	2.294	22.9	2.044	13.0

By the use of formulas (40)-(42a) for the brain and formulas (43)-(45d) for the spinal cord, the values for table 74 after 10 days of age were obtained and also those for the respective graphs in chart 26. The data for the first 10 days are from direct observations. The percentage of water in the brain and spinal cord is linked with age and is not readily modified.

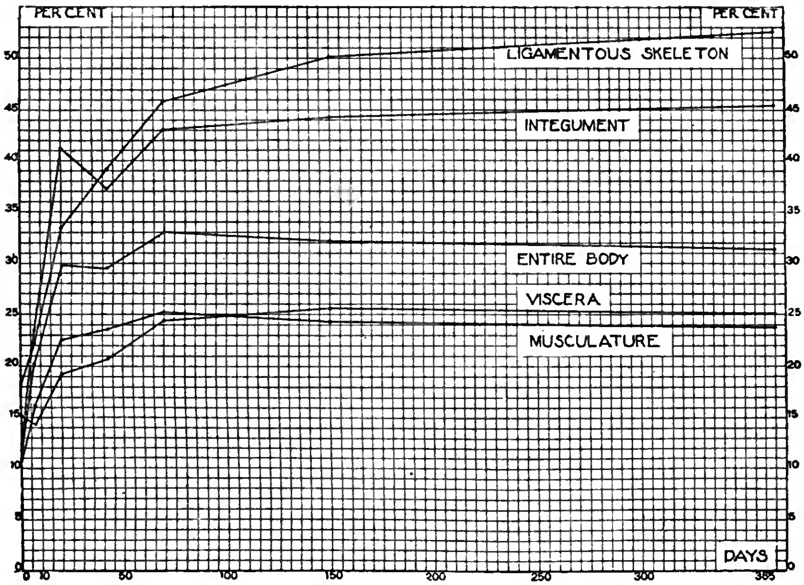

Chart 24 Giving the percentage of dry substance in the body as a whole and in the several systems at different ages. Table 75, Lowrey ('13).

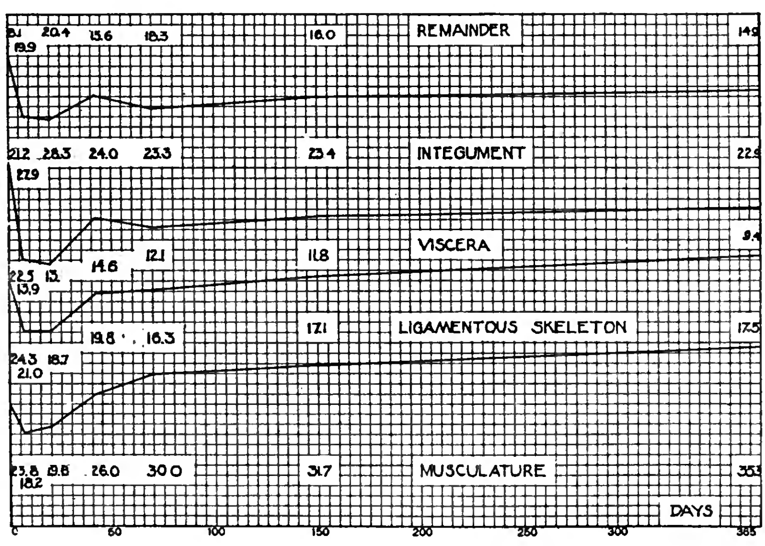

Chart 25 Giving in terms of the dry substance of the entire body the percentage values of the several systems, sexes combined. Plotted on age in days. Table 76, Lowrey ('13).

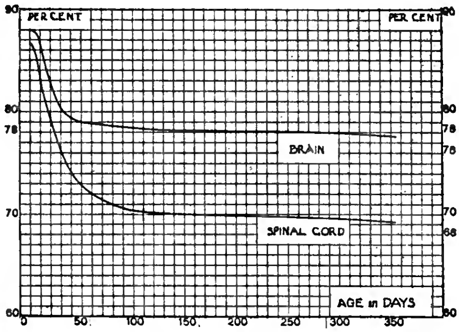

Chart 26 Giving percentage of water in the brain at different ages. Males only. Formulas (40)-(42a), table 74, and percentage of water in the spinal cord. Males only. Formulas (43)-(45d), table 74.

TABLE 76

Giving the percentage weight of the dry substance in the integument, skeleton (ligamentous), musculature, viscera and remainder in terms of the dry substance of the entire body, Lowrey '13. See chart 25

AGE IN DAYS	NUMBER OF ANIMALS	ABSOLUTE WEIGHT OF DRY SUBSTANCE ENTIRE BODY	PERCENTAGE WEIGHT OF DRY SUBSTANCE OF ENTIRE BODY REPRESENTED BY				
			Skin	Skeleton (ligamentous)	Musculature	Viscera	Remainder
0......	7...	0.494	21.2	24.3	23.8	22.5	8.1
7......	10[1]	1.830	27.9	20.1	18.2	13.9	19.9
20......	9	7.320	28.3	18.7	19.6	13.0	20.4
42......	10	17.300	24.0	19.8	26.0	14.6	15.6
70......	7[1]	42.400	23.3	16.3	30.0	12.1	18.3
150......	10	60.600	23.4	17.1	31.7	11.8	16.0
365 (?)..	2	84.300	22.9	17.5	35.3	9.4	14.9

[1] Skeleton and musculature not separately determined in one instance.

GROWTH IN TERMS OF WATER AND SOLIDS: REFERENCES

Cavazzani and Muzzioli, '12. Donaldson. '10, '11 a, '11 b. King, '11. Lowrey, '13. Weisbach, 1868.

CHAPTER 9

GROWTH OF CHEMICAL CONSTITUENTS

1. In the body as a whole. 2. In the nervous system.

1. *In the body as a whole.* For the body as a whole Hatai (MS '15) has made a determination of its composition in terms of proteins, fat, organic extract and salts, at eight ages. The results are given in table 77.

TABLE 77.

Giving the chemical composition of albino rat. Hatai (MS '15)

Age, days	Birth	7	15	22	28	35	42	294
Body gms	4.3	10.2	13.5	24.9	47.3	52.5	65.8	277.5
Water, per cent	87.2	79.8	72.9	70.6	69.6	70.6	69.4	65.3
Solids, gms	0.6	2.1	3.7	7.3	14.4	15.5	20.1	96.4
Percentages of								
Residue	56.9	42.0	39.9	38.8	38.6	44.9	44.4	44.5
Fat	14.2	35.4	39.2	36.6	37.7	25.9	27.1	16.5
Organic extr	16.4	12.8	12.8	14.8	13.8	18.6	16.9	28.2
Soluble salts	6.6	4.6	3.0	3.2	3.3	1.5	2.7	2.5
Fixed salts	5.9	5.2	5.2	6.7	6.5	9.2	8.9	8.3

The following paragraphs define the terms used in table 77.

Residue. The residue is represented by the solids from which all the organic substances soluble in both boiling alcohol and in water, as well as the salts have been removed. Thus the residue as here defined represents practically all the protein substances.

Fat. Fat is represented by the substances soluble in boiling alcohol from which the water soluble organic extractives and salts have been removed.

Organic extractives. All water soluble substances from which the salts were removed are called the organic extractives.

Soluble salts. The salts here designated were obtained from all the extractives with both water and alcohol.

Fixed salts. The solids from which fat, organic extractives and soluble salts had been removed were incinerated and the ash thus obtained is here called the fixed salts. Thus these fixed salts present practically all salts present in the osseous system.

Using a different plan of analysis McCollum ('09) has given data on the composition of the rat. The results appear in table 78. To obtain the skeleton he boiled the entire animal and then separated the skeleton from the boiled tissues.

TABLE 78.

Giving the composition of rats used in experiments with various rations. (McCollum '09)

RATION	NUMBER OF RAT	BODY WEIGHT	SKELETON	DRY TISSUE LESS SKELETON	ETHER EXTRACT	ASH OF SKELETON	SKELETON PER CENT OF LIVE WEIGHT	FAT AND WATER-FREE TISSUES PER CENT OF LIVE WEIGHT
		grams	*grams*	*grams*	*grams*	*grams*		
Normal...........	1	147	6.67	38.0	8.89	3.79	4.54	19.80
Normal...........	2	157	6.50	45.0	10.80	3.85	4.14	21.79
Normal...........	10	34	1.33	9.5	3.25	0.68	3.91	18.39

In connection with a study of the phosphorus compounds in the Albino after ovariotomy Heymann ('04) has recorded the P_2O_5 distribution in the normal rat (see Keith and Forbes, '14). His data for the normal appear in table 79.

TABLE 79.

Giving the phosphorus compounds of rats as affected by ovariotomy (Heymann, '04)

	TISSUES, PER CENT OF DRY SUBSTANCE				BONES, PER CENT TOTAL P_2O_5		BONES AND TISSUES TOTAL P_2O_5
	Lecithin P_2O_5	Nuclein P_2O_5	Phosphate P_2O_5	Total P_2O_5	Fresh substance	Dry substance	Per cent of total body weight
Normal.....	0.4760	0.0559	2.4479	2.9798	21.2690	24.0556	1.9819
Normal.....					18.1665	22.8105	1.2980
Normal.....	0.3242	0.0649	1.6490	1.9830[1]	17.0315	19.2083	?
Normal.....	0.3608	0.0979	1.5430	2.0018	17.5724	19.9277	1.3795

[1] Apparently erroneous since the sum of the figures for nuclein, lecithin and phosphate phosphorus is 2.0381 per cent.

2. *In the nervous system.* With the purpose of following the changes in the chemical constituents of the brain with advancing age, Koch, W. and M. L. ('13 a) have made a series of observations and to these have been added also observations on one spinal cord at 120 days. The results are given in tables 80 and 81.

TABLE 80

Chemical composition of the brain of the albino rat at different ages

Age in days	1		10		20		40		120		210	120 *Cord of the albino rat.* (Inserted for comparison.)
Body weight in grams	5.5		12		20		43		112.3		182	112.3
Moist weight of one brain in grams	0.250	0.250	0.860	0.860	1.228	1.329	1.397	1.368	1.659	1.551	1.667	0.365
Solids in per cent	10.420	10.420	14.700	12.500	17.500	17.500	20.100	20.580	21.600	21.700	21.900	27.100
Dry weight of one brain in grams	0.026	0.026	0.127	0.107	0.215	0.233	0.281	0.282	0.358	0.336	0.365	0.099
Number of brains in sample	100	100	40	40	48	59	37	34	30	31	31	90
Constituents in per cent of solids												
Proteins	58.200	58.300	56.400	56.500	53.900	52.700	48.700	48.100	47.200	48.000	48.500	32.800
Phosphatides	14.800	15.600	10.600 (?)	12.300	21.100	21.700	20.000	23.200	21.900	21.300	22.000	25.300
Cerebrosides	*	*	*	*	3.100	2.900	6.300	5.500	6.600 (?)	8.400	8.40‡	12.500
Sulphatides	1.500	1.400	0.730 (?)	2.600	2.400	2.600	2.700	2.400	3.500	3.600	4.500	7.000
Organic extractives, Inorganic constituents	16.500	19.300	19.300	15.100	13.800	15.300	13.800	15.900	9.700	9.800	9.80‡	7.600
Cholesterol (undetermined)†	9.000	5.400	13.000	13.500	5.700	4.800	8.000	4.900	11.100	8.900	6.800	14.800
Total sulphur	0.960	1.040	0.720	0.830	0.690	0.700	0.580	0.520	0.550	0.570	0.580	0.450
Total phosphorus	1.820	1.920	1.280	1.480	1.660	1.670	1.550	1.500	1.400	1.440	1.390	1.440
Distribution of sulphur in per cent of total S												
Protein S	31.100	30.000	48.600	44.200	57.500	55.300	65.100	62.400	61.200	62.400	63.800	53.600
Lipoid S	3.200	2.800	2.200	6.100	6.700	7.500	9.200	10.100	12.800	12.500	15.600	30.900
Neutral S	49.100	47.300	45.100	45.400	29.700	27.500	17.000	19.300	19.200	18.300	14.500	10.300
Inorganic S	16.600	19.900	4.100	4.300	6.100	9.700	8.700	8.200	6.800	6.800	6.100	5.100
Distribution of phosphorus in per cent of total P												
Protein P	13.300		13.000	13.900	6.000	5.800	9.900	7.500	7.400	7.300	6.800	5.600
Lipoid P	33.200	33.000	33.800	36.100	52.200	53.500	56.100	58.500	65.800	62.300	67.600	77.400
Water Sol. P	53.500	53.600	53.200	50.000	41.800	40.700	34.000	34.000	26.800	30.400	25.600	17.000

* Cerebrosides not determined in brains at birth and 10 days. Probably none present at this age.

† By difference. ? Indicates doubtful result. ‡ Taken from W. 8.

TABLE 81.

Absolute weights, in milligrams, of the constituents of a single brain of the albino rat at different ages (prepared from Table 80)

	AGE IN DAYS					
	1	10	20	40	120	210
Moist weight of one brain in grams.....	0.250	0.860	1.280	1.380	1.600	1.670
Solids in per cent....	10.420	12.500	17.500	20.340	21.650	21.900
Dry weight of one brain in grams.....	0.026	0.107	0.224	0.281	0.347	0.365
Absolute weights in milligrams						
Proteins (1)‡.........	15.140*	60.450†	119.400*	136.000*	165.200*	177.000†
Phosphatides (2)	3.950	13.160	47.900	61.300	74.950	80.300
Cerebrosides (3)			6.700	16.600	29.150	30.660
Sulphatides (4).......	0.380	2.780	5.600	7.200	12.300	16.400
Organic extractives............ Inorganic constituents...........	4.650	16.160	32.600	41.700	33.800	35.800
Cholesterol undetermined (5).....	1.870	(14.45)	11.700	18.200	31.600	24.800
Total sulphur........	0.260	0.900	1.5700	1.540	1.940	2.120
Total phosphorus....	0.480	1.600	3.7200	4.300	4.930	5.070
In absolute weight in milligrams of sulphur						
Protein S (1S)§......	0.079	0.398	0.885	0.982	1.199	1.352
Lipoid S (4)..........	0.008	0.054	0.111	0.149	0.246	0.330
Neutral S (6)........	0.125	0.409	0.449	0.279	0.363	0.307
Inorganic S (7).......	0.047	0.039	0.122	0.130	0.132	0.129
In absolute weight in milligrams of phosphorus						
Protein P (1P).......	0.064	0.215*	0.220	0.374	0.360	0.345
Lipoid P (2).........	0.161	0.558	1.964	2.464	3.160	3.427
Water sol. P (8)......	0.260	0.826	1.532	1.462	1.410	1.298

* Record from average duplicate analyses.

† Record from one analysis.

‡ Figures in parentheses in this section refer to Chart III. See original.

§ Figures in parentheses in this and the following sections refer to Chart IV. See original.

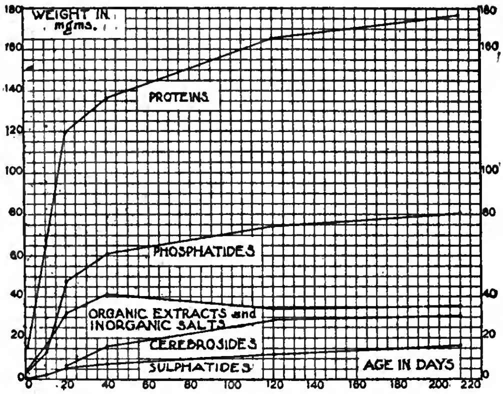

Chart 27. Giving in milligrams the absolute weight of the more important chemical constituents of the brain. Plotted on age. Table 81.

In chart 27 are given the graphs for the absolute weights of the more important chemical constituents of the brain plotted on age (see table 81).

GROWTH IN CHEMICAL CONSTITUENTS: REFERENCES

1. *Entire body.* Mendel and Daniels, '12. Pembrey and Spriggs, '04.
2. *Nervous system.* Bibra, 1854. Hatai, '09, '10. Koch, M., '13. Koch and Mann, '09. Koch and Koch, '13, '13 a.

CHAPTER 10

PATHOLOGY

1. Tumors. 2. Parasites and infections (except leprosy and plague). 3. Leprosy. 4. Plague. 5. Public hygiene. 6. Descriptive and experimental pathology. 7. Economic relations.

In the various studies on the pathology of the rat there are, of course, some data, which might be tabulated or charted. It has been thought best however to adhere to our general plan of treating in detail the data for the normal animal only and the presentation in this chapter is limited therefore to a series of references classified according to the subheads given above.

PATHOLOGY: REFERENCES

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2. *Parasites and infections (except plague and leprosy)*. Bacot, '14. Bahr, '06. Bancroft, 1893–1894. Bayon, '12 a. Bullock and Rohdenburg, '13. Campana, '11. Chick and Martin, '11. Currie, '10. Dean, '03. Fantham, '06. Giglio-Tos, 1900. Hurler, '12. Jungano, '09. Jurgens, '03. Laveran and Mesnil, 1900, 1900 a, 1900 b. Loghem, '08. Mallory and Ordway, '09. Mitchell, '12. Morpurgo, '01, '02. Ori, '12. Poppe, '13. Pound, '05. Rabinowitsch and Kempner, 1899. Robinson, '13. Rosenau, '01. Sabrazès and Muratet, '05. Shipley, '08. Stiles and Crane, '10. Stiles and Hassall, '10. Terry, '05. Trautmann, A., '12. Trautmann, H., '12. Wasielewski and Senn, 1900. Webel, '13–'14. Wiener, '02, '03.

3. *Leprosy*. Bayon, '11, '12, '12 b, '12 c, Chapin, '12. Dean, '05. Duval, '10, '11. Duval and Gurd, '11, '11 a. Duval and Wellman, '12. Duval and Harris, '13. Hollmann, '12. Jadassohn, '13. Leboeuf, '12. Marchoux, '10, '11, '11–'12, '12. Marchoux and Sorel, '12, '12 a, '12 b, '12 c. McCoy, '08. Tidswell and Cleland, '12. Wherry, '08. Wolbach and Honeij, '14. Zinsser and Carey, '12.

4. *Plague*. Advisory Committee, '12 b. Bacot and Martin, '14. Bannerman, '06. Blue, '08, '10. Brinckerhoff, '10. Chick and Martin, '11. Edington, '01.

'01. Galli-Valerio, '02. Gauthier and Raybaud, '03. Herzog, '05. Hossack, '07 a. India Plague Commission, '08. Liston, '05, '05 a. Loghem and Swellengrebel, '14. Martini, '01. McCoy, '10. Petrie, '10. Reports on Plague Investigations in India, '06. Thompson, '06. Tiraboschi, '02, '04, '04 a.

5. *Public hygiene.* Advisory Committee, '12 a. Bahr, '09, '09 a, '10. Bergmann, '08. Boelter, '09. Buchanan, '10. Calmette, '10, '11. Converse, '10. Cook, 1885–1886. Creel, '10. DuPuy, and Brewster, '10. Foster, '09. Fox, '12. Foy, '13. Grubbs and Holsendorf, '13. Heiser, '10, '13. Hobdy, '10. Kerr, '10. Konstansoff, '10. Kunhardt and Taylor, '15. Lagarrique, '11. Lantz, '07, '10 a. Lavrinovich, '10. Mandoul, '08–'09. Munson, '10. Neumark, '13. Pottevin, '10. Ramachandrier, '08. Reaney and Malcolmson, '08. Ringeling, '12. Rosenau, '10. Rucker, '10, '12, '13. Schern, '12. Simpson, '13. Suffolk, '10. Symposium, '11. Tailby, '11. Zuschlag, '03.

6. *Descriptive and experimental pathology.* Ascher, '10. Aumann, '12. Aunett, '08. Bainbridge, '08–'09. Bircher, '11, '11 a. Boinet, 1897, 1897 a. Bullock and Rohdenburg, '15. Cramer, '08. Czerny, 1890. Fibiger, '13, '13 a, '13 b, '14. Flexner and Noguchi, '06. Graham and Hutchison, '14. Horton, '05. Kolmer and Yui and Tyau, '13. Lewin, '12, '12 a. Loeb, '13. Mallory and Ordway, '09. Martin, 1895. Mavrojannis, '03. Mereshkowsky and Sarin, '09. Mereshkowsky, '12, '12 a. Metschnikoff and Roux, 1891. Murphy, '14. Nerking, '09. Olds, '10. Ophüls, '11. Plimmer and Thomson, '08. Remlinger, '04. Rowland, '11. Schern, '09. Schürmann, '08. Sittenfield, '12. Steffenhagen, '10.

7. *Economic relations.* Bruneau, 1886. Galli-Valerio, '08. Klunzinger, '08. Landois, 1886. Lantz, '10 b. Lersch, 1871. Loir, '03.

PART II

NORWAY RAT

CHAPTER 11

LIFE HISTORY AND DISTINGUISHING CHARACTERS

1. Introduction. 2. Life history. a. Span of life. b. Gestation period. c. Number of litters. d. Number in litter. e. Proportion of sexes. f. Opening of eyes. g. Age of sexual maturity. 3. Comparison of Norway with Albino. 4. Similarities of Norways and Albinos in western Europe to those of the United States.

1. *Introduction.* To obtain more complete information concerning the rat it is important to note differences which may appear between the domesticated Albino and the wild Norway. Since the wild Norway represents the parent stock it might seem proper to use that form as the standard and to record the deviations of the Albino from it. As a matter of fact however our information with regard to the Albino is so much the more complete that the best results will follow from using it as the standard, despite the fact that zoölogically it is but a variety of the Norway.

2. *Life history of the Norway rat.* As regards behavior, the Norway rat is very responsive to sounds, gnaws its cage, burrows when opportunity offers, is hard to handle and appears fierce because usually in a state of terror, yet after some days in a cage, it often becomes quite docile.

Mus norvegicus when mature weighs 300–500 grams. (550 grams = $1\frac{1}{4}$ pounds avd., has been reported but is very unusual). We have recorded one male with a body weight of 523 gms. The color above ranges from light gray or orange to brown and dark gray, usually with more or less white or light gray on the ventral surfaces. Melanic sports occasionally occur (see p. 14, note 5). Mus norvegicus is distinguished from Mus rattus, the house rat, by the following superficial characters: larger size; blunter head; smaller ears which are thicker and more covered with hair; tail shorter than body; claws usually relatively dull. Its movements are less rapid. Commonly the female Norway has twelve, sometimes fourteen nipples, while the house rat has very constantly ten.

a.) Span of life. The span of life of the Norway rat is not known. It seems probable that it is between three and four years, though here and there individuals may live somewhat longer.

b.) Period of gestation: 21 days Lantz ('09); 23.5–25.5 days Miller ('11). The latter periods are possibly due to the effect of nursing on gestation. See p. 22.

c.) Number of litters. Miller ('11) reports seven litters in seven months from a single pair, and estimates that, in general, five to six litters may be easily reared by a single pair in a year.

d.) Number of young in a litter. Climate and station appear as general modifying influences. Larger litters are reported from northern Europe than from India (Lantz, '09).

Crampe ('84) obtained an average of 10.4 in fourteen litters.

Zuschlag ('03) states that among the rats examined at Copenhagen in 1899, fetuses to the number of 14 were found four times and he himself in 1902 examined one female bearing 16. Donaldson (MS, '09) also noted in a rat taken in Paris, 16 fetuses.

The India Plague Commission reports ('08) that the average number of fetuses found in females was 8.1 from a total of 12,000 Norway rats.

According to Lantz ('09) the maximum size of litters recorded in England (Field) are 17, 19, 22 and 23; in India however 14.

The maximum numbers just given as recorded in England are not trustworthy as they represent merely the number of young found in a single nest. Since two different litters are sometimes reared in the same nest the inference from the number in the nest to the number in the litter is not convincing. Lantz ('09) assumes the average litter (in north temperate latitude) to be about 10. This is what Miller ('11) (vide infra) and Crampe ('84) (vide supra) found.

Miller ('11) observed in a group of eight litters 7–12 young in a litter, with an average of 10.5.

e.) Proportion of the sexes. Lantz ('09) and others state that the males are in excess. Donaldson ('12) found the same in trapped series taken in Paris and London. In a small series

trapped in Vienna however, the females were in excess. There are no observations on the proportions of the sexes at birth in general population, but in a special study of "extracted" Norways made by King (MS., '15) 56 litters from females—themselves taken from litters in which the two sexes were equally or nearly equally represented—gave 212 males and 213 females.

f.) *Opening of eyes.* Miller ('11) found the eyes to open at 16 or 17 days and also states that the young are weaned during the sixth week.

g.) *Age of sexual maturity.* Miller ('11) gives one instance of a female conceiving at the age of 120 days.

Owing to the difficulty of keeping M. norvegicus happy and contented in captivity, it has not yet been possible to get a trustworthy record for increase in body weight with age in the case of this form. Neither our own data (Donaldson and Hatai, '11) nor those of Miller ('11) show what must be the normal rate of increase in body weight.

3. *Comparison of the Norway with the Albino.* To determine whether the wild Norway form, as trapped in Philadelphia, differs in any way from the albino rats in the colony at The Wistar Institute, a comparison has been made between the two forms in respect to body length, body weight, brain weight, spinal cord weight and the percentage of water in both the brain andthe spinal cord (Donaldson and Hatai, '11) as well as the weights of several of the parts and viscera. (Jackson and Lowrey, '12; Hatai, '14 a.)

In addition to the familiar facts that the Norway rat is more wild and difficult to handle, more successful in escaping from cages and much more given to gnawing than is the Albino, that it grows bigger, breeds later, has larger litters and a longer sexual life (Crampe, '84) it is now possible to make several further statements.

At birth the Norway is somewhat heavier than the stock Albino (King, '15, table 1) but in their relative body length and the relative weights of the brain and spinal cord, as well as in the percentage of water in these two divisions of the central nervous system, they are approximately alike.

The marked differences between the two forms appear later, during the period of rapid growth. Grouping together the general differences subsequently found, we may say that the Norway rat is absolutely much heavier, relatively slightly longer, has a relatively heavier brain and a heavier spinal cord, and since for the same body weight as a given Albino it is younger, it has when so compared a higher percentage of water in the central nervous system.

For the same age however, the percentages of water are *nearly* alike; the percentage in the Norway rat being a trifle higher (Donaldson and Hatai, '11). The relative weights of the ovaries, testes and suprarenals are also greater (C. Watson, '07; Hatai, '14). These plus characters of the Norway tend to disappear when the Norway is subjected to domestication.

The deviations of the Norway may be expressed in another way. When the body weights of Norway and Albino are the same:

The Norway rat has a greater body length; a greater brain weight; a greater spinal cord weight; a higher percentage of water in the central nervous system; heavier ovaries, testes and suprarenals.

When body lengths are the same:

The Norway rat has a smaller body weight; a greater brain weight; a greater spinal cord weight; a higher percentage of water in the central nervous system; heavier ovaries, testes and suprarenals.

When brain weights are the same:

The Norway rat has a smaller body weight; a smaller body length; a smaller spinal cord weight; a higher percentage of water in the central nervous system.

When the spinal cord weights are the same:

The Norway rat has a smaller body weight; a smaller body length; a greater brain weight; a higher percentage of water in the central nervous system.

Speaking generally therefore we may say that when compared with the domesticated Albino, the wild Norway rat weighs more, is longer and possesses a nervous system in which both the brain and spinal cord are relatively larger.

These differences taken together indicate that the *albino rat* has grown less well, and it seems most natural to attribute the lack of growth to the whole set of conditions summed up in the word 'domestication.'

The most marked difference in structure thus far described between the two forms is in the relative weight of the central nervous system. That this is due to the effects of domestication seems highly probable, in view of the observations of Darwin ('83) and Lapicque and Girard ('07).

There are still other observations which belong here. In a study on the weight of some of the ductless glands of the Norway and of the albino rat according to sex and variety Hatai, ('14 a) an examination was made of the suprarenals, hypophysis, thyroid and gonads in both forms. The conclusions reached are here given.

In both the Norway and albino rats the suprarenal glands of the males are considerably smaller than those of the females. When, however, these two forms of rats are compared, both sexes of the Norway rats have suprarenals considerably heavier than those of the like sexes of the Albino.

A sex difference is noted in the weight of the hypophysis in both the Norway and albino rats. The male hypophysis is lighter than that of the female. However, when these two forms of rats are compared, the hypophysis of the Norway is found to be smaller than that of the albino rat; the greater difference being in the case of the female.

Neither in the Norway nor the albino rat is a sex difference found in the weight of the thyroid. Moreover, there is no weight difference in the thyroid according to variety in the case of these two forms of rats.

The sex glands (testes and ovaries) of the Norway rats are heavier than those of the albino rats.

Hatai is also of the opinion that the differences noted are again the result of a response to domestication.

4. *Similarity of the Norways and Albinos of western Europe to those of the United States.* It is to be noted in this connection that so far as tests have been made, the albino rats found in Europe

are similar to those found in America. For the Albinos from Vienna, Paris and London, the determinations were made by Donaldson ('12) and Chisolm ('11) has reported on the relation of body length to body weight in albino and pied rats in London. Chisolm compares his determinations of length with those by Donaldson ('09) and when correction is made for the slight difference in the methods of measurements, the two sets of results agree nicely.

It is also true that the wild Norways of Europe seem to be similar to those of the United States (Donaldson, '12) so that the differences above noted probably will be found at whatever stations the two forms are compared.

LIFE HISTORY—NORWAY RAT: REFERENCES

Chisolm, '11. Crampe, 1884. Darwin, 1883. Donaldson, '09, '11, '12. Donaldson and Hatai, '11. Hatai, '14 a. India Plague Commission, '08. Jackson and Lowrey, '12. Lantz, '09. Lapicque and Girard, '07. Miller, '11. Watson, C., '07. Zuschlag, '03.

CHAPTER 12

GROWTH IN WEIGHT OF PARTS AND SYSTEMS OF THE BODY

1. Growth of parts. 2. Growth of systems. 3. Weight of cranium.

1. *Growth of parts of the body.* For the general conditions under which these observations were made by Jackson and Lowrey ('12), see pp. 73–74.

Five Norways only were examined, these having been trapped in barns at the University of Missouri. They were probably living on grain. As will be seen by reference to table 82 the smallest of these, a male, weighed 65 grams and was therefore probably from three to five weeks old. The percentage relations of the several parts of the body are given in table 82.

TABLE 82

Norway rat—Percentage weights of head, trunk and extremities. Sexes combined (Jackson and Lowrey, '12)

SEX	NET BODY WEIGHT	HEAD	FORE LIMBS	HIND LIMBS	TRUNK
	grams	*per cent*	*per cent*	*per cent*	*per cent*
M	65.0	14.66	5.95	13.88	65.51
M	95.4	12.17	5.83	15.34	66.66
F	107.5	10.18	5.58	15.81	68.43
M	164.0	9.27	5.24	14.94	70.55
F	254.0[1]	7.85	5.02	13.68	73.45

[1] Including gravid uterus, which weighed 13.76 grams.

On comparing the relative values here given with those for the albino rat (see p. 74) it appears that for corresponding body weights the average values for the fore limbs and hind limbs are low, while those for the trunk are high—a relation which might be expected in view of the greater body length of the Norway—see tables 49 and 82.

TABLE 83

Norway rat—Percentage of total body weight represented by the weight of integument, ligamentous skeleton, musculature, viscera and remainder. (Jackson and Lowrey, '12)

SEX	NET BODY WEIGHT	INTEGUMENT	LIGAMENTOUS SKELETON	MUSCULATURE	VISCERA	REMAINDER
	grams	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
M.......	65.0	18.42	13.15	35.39	23.40	9.64
M.......	95.4	19.29	13.85	38.57	23.21	5.08
F........	107.5	20.37	13.86	42.14	17.51	6.12
M.......	164.0	17.35	13.29	41.66	20.95	6.75
F........	254.0[1]	19.41	10.16	44.21	16.22	10.00

[1] Including gravid uterus, which weighed 13.76 grams.

2.) Growth of systems. When the values for the five entries in table 83 are compared with the last four in table 50 for the albino rat, it is noted that in the Norway the values for the musculature and viscera are high, while that for the 'remainder' is low. This last difference is due in part to the smaller amount of fat in the Norway. At the same time there is other evidence to show that for the same body weight as the Albino, both the trunk and the viscera of the Norway are heavier, as here found.

3.) Weight of cranium. (Donaldson, '12.) Determinations of the weight of the cranium dried at room temperature have

TABLE 84

The mean weight in grams of the crania in each body weight group of the four series of wild Norway rats from Paris, London, Philadelphia, Vienna (based on table 1 Donaldson, '12 a.) Each weight group is based on six cases; 3 males and 3 females

BODY WEIGHT GROUP	WEIGHT OF THE CRANIA IN GRAMS			
	LONDON	PARIS	PHILADELPHIA	VIENNA
grams				
125.............	1.17	1.27	1.13	1.10
175.............	1.58	1.58	1.34	1.37
225.............	1.84	1.91	1.71	1.70
275.............	2.25	2.17	2.14	1.90
325.............	2.69	2.60	2.40	2.27
375.............	3.13	2.98	2.86	2.48

For the corresponding weights of the albino crania see table 55.

been made. By the cranium is meant the skull with upper teeth, minus the mandible with lower teeth and the ear bones. The mean weights are given in table 84.

GROWTH IN WEIGHT OF PARTS AND SYSTEMS OF THE BODY: REFERENCES

Donaldson, '12 a. Jackson and Lowrey, '12.

CHAPTER 13

GROWTH OF ORGANS IN RELATION TO BODY LENGTH—NORWAY

1. Length of tail and weights of body, brain and spinal cord in relation to body length. 2. Weight—length ratios.

1) *Length of tail, body weight, brain weight and spinal cord weight in relation to body length.* Before passing to the tables on the Norway rat, it should be pointed out that the observations used for them have been made on the Norway rat as found in Philadelphia. At the same time it has been shown that the Norway rat taken in Vienna, Paris and London is similar in its general form to that found in the United States, so that the determinations in the tables may be applied to the Norway rat in Europe also (Donaldson, '12).

Table 85 contains values for the several characters named above, computed by the formulas devised by Hatai; these formulas being in turn based on series of observations, the number of which is given in each case.

Body length on body weight. From the study of 282 male and 318 female Norway rats, trapped in Philadelphia, measurements have been taken for body weight and body length (Donaldson and Hatai, '11).

The values for body length—sexes combined—on body weight are given by formula (46). In chart 28 the corresponding graph is given and for comparison the graph for the body length of the Albino is also drawn (see formula (1)).

It has been found that for a given body weight, the body length is in the male Norway 0.4 per cent above the mean, and in the female 0.4 per cent below (Donaldson and Hatai, '11, p. 425).

Body weight on body length. When the formula (46) is transformed so as to give the body weight for a given body length and the correction for sex is included, we have for the males formula (47) and for the females formula (48). In chart (29) are given the graphs for both sexes.

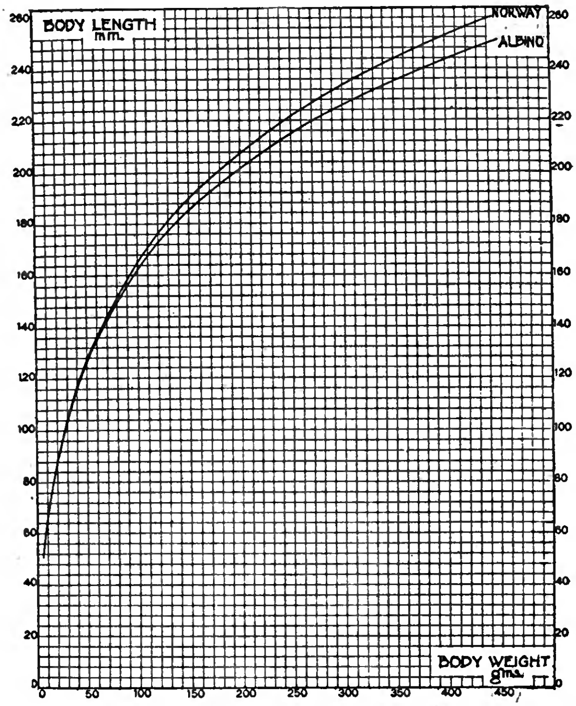

Chart 28 Norway rat—Giving body length on the body weight. Males only. Formula (46), table 85. Inserted for comparison is the corresponding graph for the male Albino (see formula (1).

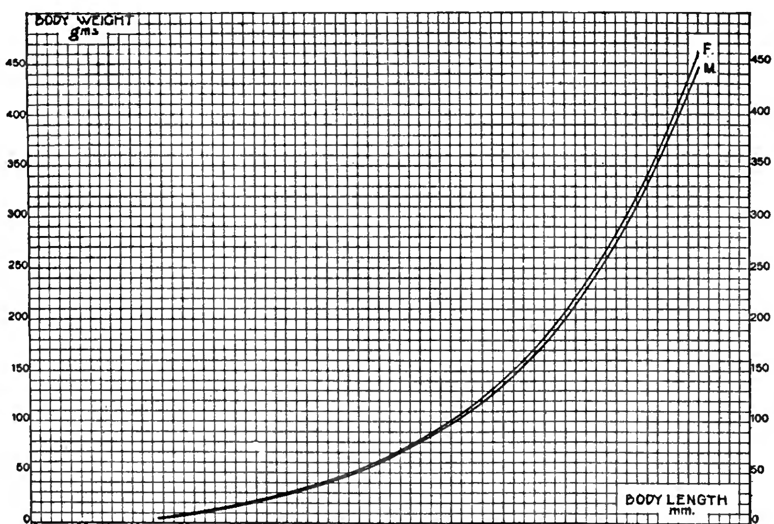

Chart 29 Norway rat—Giving the body weight on the body length. Males, females. Formulas (47), (48), table 85.

Body weight of the Norway on the body weight of the Albino. Formula (49) gives the body weight of the Norway on the body weight of the Albino for a limited range of Albino body weights.

Tail length on body length. The tail length on the body length has been determined by Hatai (MS '14) and is represented by formulas (50) and (51) for the male and female re-

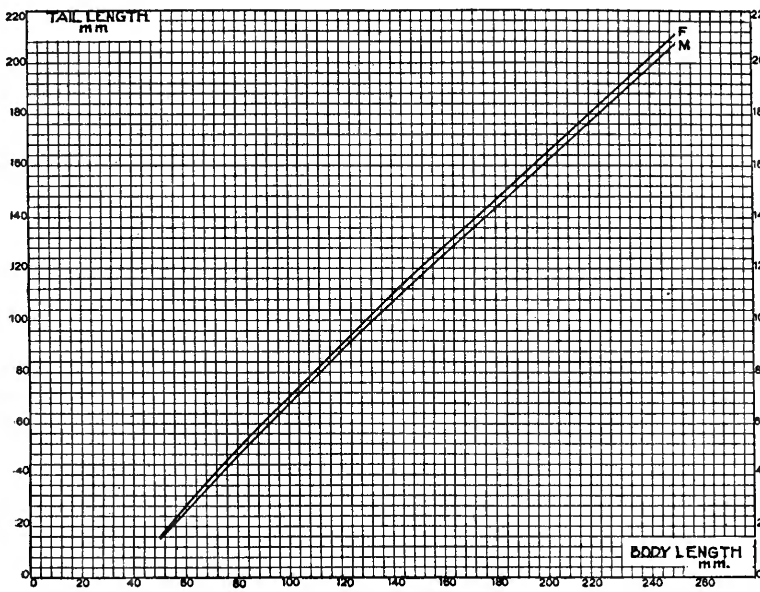

Chart 30 Norway rat—giving the tail length on the body length. Males, females. Formulas (50), (51), table 85.

spectively. As can be seen by consulting table 85 the males have the shorter tails—a relation which agrees with that found for the Albino. In chart 30 are given the corresponding graphs.

Brain weight on body weight. The direct determinations of the weight of the brain have been made on 232 males and 278 females. The general formula (52) expresses the relation of brain weight on body weight for the sexes combined.

It applies however only to rats with a body weight above five grams.

Using this formula the brain weights have been computed for each of the series of body weights as determined by formulas (47) and (48).

It has been found however (Donaldson and Hatai, '11, p. 428) that the weight of the male brain is one per cent above the mean for the two sexes, and that of the female, one per cent below.

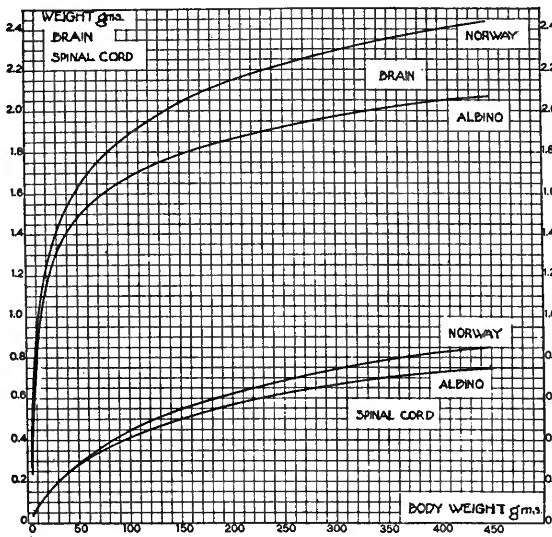

Chart 31 Norway rat, giving brain weight on the body weight. Males only. With the corresponding graph for the Albino inserted for comparison. Formula 52, table 85. Also the spinal cord weight on the body weight. Males only. With the corresponding graph for the Albino inserted for comparison. Formula 54, table 85.

As a consequence, each value gotten by the foregoing computations has been corrected by adding one per cent to the value found to give the weight for the male brain and by subtracting one per cent to obtain the weight for the female brain.

Chart 31 gives the graph for the male brain weight on the body weight and the corresponding graph (male) for the Albino (see chart 9) is also drawn for comparison. The marked difference in the brain weight of the two forms is clearly shown.

Formula (53) gives the cranial capacity for the body weight—a useful datum in many instances.

Spinal cord weight on body weight. In the case of the spinal cord, the computation was made for the sexes combined by the aid of formula (54). Here again there is a difference according to sex, the male spinal cord exceeding the female by 0.2 per cent, and the value for both sexes combined, by 0.1 per cent. Corrections similar to those applied to the brain have been made in this case also. Chart (31) gives the graph for the male spinal cord on body weight and the corresponding graph (male) for the Albino (see chart 9) is also drawn for comparison.

Formula (55) gives the spinal cord weight (sexes combined) on the brain weight—sexes combined, table 85.

2. *Weight-length ratios.* In table 86 are given the values for the Norway obtained by dividing the body weight by the body length, as these appear in table 85.

The explanation of the use of this table has been given on p. 72 in connection with the corresponding table 48 for the Albino.

GROWTH OF ORGANS IN RELATION TO BODY LENGTH: REFERENCES

Donaldson, '12, '12 a. Donaldson and Hatai, '11.

TABLE 85

Gives the tail length, body weight, brain weight and spinal cord weight for each millimeter of body length of the male and female Norway rat respectively.
See Charts 28, 29, 30, 31.

MALES					FEMALES			
Body length	Tail length	Body weight	Weight of Brain	Weight of Spinal cord	Tail length	Body weight	Weight of Brain	Weight of Spinal cord
mm.	*mm.*	*gms.*	*gms.*	*gms.*	*mm.*	*gms.*	*gms.*	*gms.*
50	15.0	4.4		0.031	16.0	4.6		0.032
51	16.2	4.8		0.034	17.2	4.9		0.035
52	17.3	5.1	0.270	0.037	18.4	5.2	0.307	0.038
53	18.5	5.4	0.367	0.040	19.6	5.6	0.393	0.041
54	19.6	5.8	0.443	0.043	20.8	5.9	0.462	0.044
55	20.8	6.1	0.508	0.046	21.9	6.3	0.522	0.047
56	21.9	6.5	0.563	0.049	23.1	6.6	0.574	0.050
57	23.0	6.8	0.611	0.052	24.3	7.0	0.620	0.053
58	24.1	7.2	0.655	0.055	25.4	7.4	0.661	0.056
59	25.3	7.6	0.694	0.058	26.5	7.7	0.698	0.059
60	26.4	7.9	0.730	0.061	27.7	8.1	0.732	0.063
61	27.5	8.3	0.763	0.064	28.8	8.5	0.763	0.066
62	28.6	8.7	0.794	0.067	29.9	8.9	0.793	0.069
63	29.7	9.1	0.823	0.070	31.1	9.3	0.820	0.072
64	30.8	9.5	0.850	0.074	32.2	9.7	0.846	0.075
65	31.9	9.9	0.875	0.077	33.3	10.1	0.871	0.078
66	32.9	10.3	0.900	0.080	34.4	10.5	0.894	0.082
67	34.0	10.7	0.923	0.083	35.5	10.9	0.916	0.085
68	35.1	11.1	0.944	0.086	36.6	11.3	0.937	0.088
69	36.2	11.5	0.965	0.090	37.7	11.8	0.957	0.091
70	37.2	11.9	0.985	0.093	38.8	12.2	0.977	0.095
71	38.3	12.4	1.005	0.096	39.9	12.6	0.995	0.098
72	39.4	12.8	1.023	0.099	41.0	13.1	1.013	0.101
73	40.4	13.3	1.041	0.103	42.1	13.5	1.031	0.104
74	41.5	13.7	1.059	0.106	43.1	14.0	1.048	0.108
75	42.5	14.2	1.075	0.109	44.2	14.5	1.064	0.111
76	43.6	14.7	1.092	0.113	45.3	14.9	1.080	0.114
77	44.6	15.1	1.107	0.116	46.4	15.4	1.095	0.118
78	45.7	15.6	1.123	0.119	47.4	15.9	1.110	0.121
79	46.7	16.1	1.138	0.123	48.5	16.4	1.124	0.125
80	47.7	16.6	1.152	0.126	49.5	16.9	1.138	0.128
81	48.8	17.1	1.166	0.129	50.6	17.4	1.152	0.131
82	49.8	17.6	1.180	0.133	51.7	17.9	1.166	0.135

TABLE 85—Continued

MALES					FEMALES			
Body length	Tail length	Body weight	Weight of: Brain	Weight of: Spinal cord	Tail length	Body weight	Weight of: Brain	Weight of: Spinal cord
mm.	*mm.*	*gms.*	*gms.*	*gms.*	*mm.*	*gms.*	*gms.*	*gms.*
83	50.8	18.1	1.194	0.136	52.7	18.5	1.179	0.138
84	51.9	18.7	1.207	0.140	53.8	19.0	1.192	0.142
85	52.9	19.2	1.220	0.143	54.8	19.6	1.204	0.145
86	53.9	19.7	1.232	0.146	55.8	20.1	1.216	0.149
87	54.9	20.3	1.245	0.150	56.9	20.7	1.229	0.152
88	55.9	20.8	1.257	0.153	57.9	21.2	1.240	0.156
89	57.0	21.4	1.269	0.157	59.0	21.8	1.252	0.159
90	58.0	22.0	1.281	0.160	60.0	22.4	1.264	0.163
91	59.0	22.5	1.292	0.164	61.0	23.0	1.275	0.166
92	60.0	23.1	1.303	0.167	62.1	23.6	1.286	0.170
93	61.0	23.7	1.315	0.171	63.1	24.2	1.297	0.173
94	62.0	24.3	1.325	0.174	64.1	24.8	1.307	0.177
95	63.0	25.0	1.336	0.178	65.1	25.4	1.318	0.180
96	64.0	25.6	1.347	0.181	66.1	26.1	1.328	0.184
97	65.0	26.2	1.357	0.185	67.2	26.7	1.338	0.188
98	66.0	26.9	1.368	0.189	68.2	27.4	1.348	0.191
99	67.0	27.5	1.378	0.192	69.2	28.0	1.358	0.195
100	68.0	28.2	1.388	0.196	70.2	28.7	1.368	0.198
101	69.0	28.8	1.398	0.199	71.2	29.4	1.378	0.202
102	70.0	29.5	1.408	0.203	72.2	30.1	1.388	0.206
103	71.0	30.2	1.417	0.207	73.2	30.8	1.397	0.209
104	72.0	30.9	1.427	0.210	74.2	31.5	1.406	0.213
105	73.0	31.6	1.436	0.214	75.2	32.2	1.416	0.217
106	73.9	32.3	1.446	0.218	76.2	33.0	1.425	0.220
107	74.9	33.1	1.455	0.221	77.2	33.7	1.434	0.224
108	75.9	33.8	1.464	0.225	78.2	34.5	1.443	0.228
109	76.9	34.6	1.473	0.229	79.2	35.2	1.452	0.232
110	77.9	35.3	1.482	0.232	80.2	36.0	1.460	0.235
111	78.8	36.1	1.491	0.236	81.2	36.8	1.469	0.239
112	79.8	36.9	1.499	0.240	82.2	37.6	1.477	0.243
113	80.8	37.7	1.508	0.244	83.2	38.4	1.486	0.247
114	81.8	38.5	1.517	0.247	84.2	39.3	1.494	0.250
115	82.7	39.3	1.525	0.251	85.2	40.1	1.503	0.254
116	83.7	40.2	1.534	0.255	86.2	40.9	1.511	0.258
117	84.7	41.0	1.542	0.259	87.2	41.8	1.519	0.262
118	85.6	41.9	1.550	0.262	88.1	42.7	1.527	0.266

TABLE 85—Continued

MALES					FEMALES			
Body length	Tail length	Body weight	Weight of		Tail length	Body weight	Weight of	
			Brain	Spinal cord			Brain	Spinal cord
mm.	*mm.*	*gms.*	*gms.*	*gms.*	*mm.*	*gms.*	*gms.*	*gms.*
119	86.6	42.7	1.558	0.266	89.1	43.6	1.535	0.269
120	87.6	43.6	1.567	0.270	90.1	44.5	1.543	0.273
121	88.5	44.5	1.575	0.274	91.1	45.4	1.551	0.277
122	89.5	45.4	1.583	0.278	92.1	46.3	1.559	0.281
123	90.5	46.3	1.591	0.281	93.0	47.3	1.567	0.285
124	91.4	47.3	1.599	0.285	94.0	48.2	1.575	0.289
125	92.4	48.2	1.606	0.289	95.0	49.2	1.582	0.292
126	93.4	49.2	1.614	0.293	96.0	50.2	1.590	0.296
127	94.3	50.2	1.622	0.297	96.9	51.2	1.598	0.300
128	95.3	51.1	1.630	0.301	97.9	52.2	1.605	0.304
129	96.2	52.1	1.637	0.305	98.9	53.2	1.613	0.308
130	97.2	53.2	1.645	0.308	99.8	54.2	1.620	0.312
131	98.1	54.2	1.652	0.312	100.8	55.3	1.627	0.316
132	99.1	55.3	1.660	0.316	101.8	56.4	1.635	0.320
133	100.0	56.3	1.667	0.320	102.7	57.5	1.642	0.324
134	101.0	57.4	1.675	0.324	103.7	58.6	1.649	0.328
135	101.9	58.5	1.682	0.328	104.7	59.7	1.657	0.332
136	102.9	59.6	1.689	0.332	105.6	60.9	1.664	0.336
137	103.8	60.7	1.697	0.336	106.6	62.0	1.671	0.339
138	104.8	61.9	1.704	0.340	107.5	63.2	1.678	0.343
139	105.7	63.0	1.711	0.344	108.5	64.3	1.685	0.347
140	106.7	64.2	1.718	0.348	109.5	65.6	1.692	0.351
141	107.6	65.4	1.725	0.352	110.4	66.8	1.699	0.355
142	108.6	66.6	1.732	0.356	111.4	68.0	1.706	0.359
143	109.5	67.8	1.739	0.360	112.3	69.3	1.713	0.363
144	110.5	69.1	1.746	0.363	113.3	70.6	1.720	0.368
145	111.4	70.4	1.753	0.367	114.2	71.9	1.727	0.372
146	112.3	71.6	1.760	0.371	115.2	73.2	1.733	0.376
147	113.3	72.9	1.767	0.375	116.1	74.5	1.740	0.380
148	114.2	74.3	1.774	0.379	117.1	75.9	1.747	0.384
149	115.2	75.6	1.781	0.384	118.0	77.2	1 754	0.388
150	116.1	77.0	1.788	0.388	119.0	78.6	1.760	0.392
151	117.0	78.3	1.794	0.392	119.9	80.0	1.767	0.396
152	118.0	79.7	1.801	0.396	120.9	81.5	1.774	0.400
153	118.9	81.2	1.808	0.400	121.8	82.9	1.780	0.404

TABLE 85—Coutinued

MALES					FEMALES			
Body length	Tail length	Body weight	Weight of Brain	Weight of Spinal cord	Tail length	Body weight	Weight of Brain	Weight of Spinal cord
mm.	*mm.*	*gms.*	*gms.*	*gms.*	*mm.*	*gms.*	*gms.*	*gms.*
154	119.8	82.6	1.815	0.404	122.8	84.4	1.787	0.408
155	120.8	84.1	1.821	0.408	123.7	85.9	1.793	0.412
156	121.7	85.6	1.828	0.412	124.7	87.4	1.800	0.416
157	122.6	87.1	1.835	0.416	125.6	89.0	1.807	0.420
158	123.6	88.6	1.841	0.420	126.6	90.6	1.813	0.424
159	124.5	90.1	1.848	0.424	127.5	92.1	1.819	0.429
160	125.4	91.7	1.854	0.428	128.4	93.8	1.826	0.433
161	126.4	93.3	1.861	0.432	129.4	95.4	1.832	0.437
162	127.3	94.9	1.867	0.436	130.3	97.1	1.839	0.441
163	128.2	96.6	1.874	0.441	131.3	98.7	1.845	0.445
164	129.1	98.2	1.880	0.445	132.2	100.5	1.851	0.449
165	130.1	99.9	1.887	0.449	133.1	102.2	1.858	0.453
166	131.0	101.6	1.893	0.453	134.1	104.1	1.864	0.458
167	131.9	103.4	1.899	0.457	135.0	105.7	1 870	0.462
168	132.8	105.1	1.906	0.461	135.9	107.5	1 877	0.466
169	133.8	106.9	1.912	0.465	136.9	109.4	1.883	0.470
170	134.7	108.7	1.918	0.469	137.8	111.3	1.889	0.474
171	135.6	110.6	1.925	0.474	138.8	113.1	1.895	0.478
172	136.5	112.4	1.931	0.478	139.7	115.1	1.901	0.483
173	137.5	114.3	1.937	0.482	140.6	117.0	1.908	0.487
174	138.4	116.3	1.944	0.486	141.5	119.0	1.914	0.491
175	139.3	118.2	1.950	0.490	142.5	121.0	1.920	0.495
176	140.2	120.2	1.956	0.494	143.4	123.0	1.926	0.499
177	141.1	122.2	1.962	0.499	144.3	125.1	1.932	0.504
178	142.1	124.2	1.968	0.503	145.3	127.2	1.938	0.508
179	143.0	126.3	1.975	0.507	146.2	129.3	1.9[illegible]4	0.512
180	143.9	128.4	1.981	0.511	147.1	131.5	1.949	0.516
181	144.8	130.5	1.987	0.515	148.1	133.7	1.955	0.520
182	145.7	132.7	1.993	0.520	149.0	135.9	1.962	0.525
183	146.7	134.9	1.999	0.524	149.9	138.1	1.968	0.529
184	147.6	137.1	2.005	0.528	150.8	140.4	1.974	0.533
185	148.5	139.3	2.011	0.532	151.8	142.8	1.980	0.537
186	149.4	141.6	2.017	0.536	152.7	145.1	1.986	0.542
187	150.3	144.0	2.023	0.541	153.6	147.5	1.992	0.546
188	151.2	146.3	2.029	0.545	154.5	149.9	1.998	0.550
189	152.2	148.7	2.035	0.549	155.5	152.4	2.004	0.554
190	153.1	151.1	2.042	0.553	156.4	154.9	2.010	0.559

TABLE 85—Continued

MALES					FEMALES			
Body length	Tail length	Body weight	Weight of		Tail length	Body weight	Weight of	
			Brain	Spinal cord			Brain	Spinal cord
mm.	*mm.*	*gms.*	*gms.*	*gms.*	*mm.*	*gms.*	*gms.*	*gms.*
191	154.0	153.6	2.047	0.557	157.3	157.4	2.016	0.563
192	154.9	156.1	2.053	0.562	158.2	160.0	2.022	0.567
193	155.8	158.6	2.059	0.566	159.1	162.6	2.028	0.572
194	156.7	161.2	2.065	0.570	160.1	165.2	2.034	0.576
195	157.6	163.8	2.071	0.575	161.0	167.9	2.039	0.580
196	158.5	166.4	2.077	0.579	161.9	170.6	2.045	0.584
197	159.4	169.1	2.083	0.583	162.8	173.4	2.051	0.589
198	160.4	171.8	2.089	0.587	163.7	176.2	2.057	0.593
199	161.3	174.6	2.095	0.592	164.7	179.1	2.063	0.597
200	162.2	177.4	2.101	0.596	165.6	181.9	2.069	0.602
201	163.1	180.2	2.107	0.600	166.5	184.9	2.074	0.606
202	164.0	183.1	2.112	0.604	167.4	187.8	2.080	0.610
203	164.9	186.0	2.118	0.609	168.3	190.9	2.086	0.615
204	165.8	189.0	2.124	0.613	169.2	193.9	2.092	0.619
205	166.7	192.0	2.130	0.617	170.2	197.0	2.098	0.623
206	167.6	195.0	2.136	0.622	171.1	200.2	2.103	0.628
207	168.5	198.1	2.142	0.626	172.0	203.4	2.109	0.632
208	169.4	201.3	2.148	0.630	172.9	206.6	2.115	0.636
209	170.3	204.4	2.153	0.635	173.8	209.9	2.120	0.641
210	171.2	207.7	2.159	0.639	174.7	213.2	2.126	0.645
211	172.1	210.9	2.165	0.643	175.6	216.6	2.132	0.649
212	173.1	214.3	2.171	0.647	176.6	220.1	2.138	0.654
213	174.0	217.7	2.177	0.652	177.5	223.5	2.143	0.658
214	174.9	221.1	2.182	0.656	178.4	227.1	2.149	0.662
215	175.8	224.5	2.188	0.660	179.3	230.7	2.155	0.667
216	176.7	228.1	2.194	0.665	180.2	234.3	2.160	0.671
217	177.6	231.6	2.199	0.669	181.1	238.0	2.166	0.675
218	178.5	235.3	2.205	0.673	182.0	241.8	2.171	0.680
219	179.4	239.0	2.211	0.678	182.9	245.6	2.177	0.684
220	180.3	242.7	2.217	0.682	183.8	249.4	2.183	0.689
221	181.2	246.5	2.222	0.686	184.8	253.3	2.188	0.693
222	182.1	250.3	2.228	0.691	185.7	257.3	2.194	0.697
223	183.0	254.2	2.234	0.695	186.6	261.3	2.199	0.702
224	183.9	258.2	2.239	0.699	187.5	265.4	2.205	0.706
225	184.8	262.2	2.245	0.704	188.4	269.6	2.211	0.710
226	185.7	266.3	2.251	0.708	189.3	273.8	2.216	0.715
227	186.6	270.4	2.256	0.713	190.2	278.1	2.222	0.719

TABLE 85—Concluded

MALES					FEMALES			
Body length	Tail length	Body weight	Weight of		Tail length	Body weight	Weight of	
			Brain	Spinal cord			Brain	Spinal cord
mm.	*mm.*	*gms.*	*gms.*	*gms.*	*mm.*	*gms.*	*gms.*	*gms.*
228	187.5	274.6	2.262	0.717	191.1	282.4	2.227	0.724
229	188.4	278.8	2.268	0.721	192.0	286.8	2.233	0.728
230	189.3	283.1	2.273	0.726	192.9	291.3	2.238	0.732
231	190.2	287.5	2.279	0.730	193.8	295.8	2.244	0.737
232	191.1	292.0	2.285	0.734	194.7	300.4	2.250	0.741
233	192.0	296.5	2.290	0.739	195.6	305.1	2.255	0.746
234	192.9	301.0	2.296	0.743	196.5	309.8	2.261	0.750
235	193.8	305.7	2.301	0.748	197.4	314.6	2.266	0.754
236	194.7	310.4	2.307	0.752	198.3	319.5	2.272	0.759
237	195.5	315.1	2.312	0.756	199.2	324.4	2.277	0.763
238	196.4	320.0	2.318	0.761	200.1	329.4	2.283	0.768
239	197.3	324.9	2.324	0.765	201.1	334.5	2.288	0.772
240	198.2	329.9	2.329	0.769	202.0	339.7	2.294	0.776
241	199.1	334.9	2.335	0.774	202.9	344.9	2.299	0.781
242	200.0	340.1	2.340	0.778	203.8	350.2	2.305	0.785
243	200.9	345.3	2.346	0.783	204.7	255.6	2.310	0.790
244	201.8	350.5	2.351	0.787	205.6	361.1	2.316	0.794
245	202.7	355.9	2.357	0.791	206.5	366.7	2.321	0.799
246	203.6	361.3	2.363	0.796	207.4	372.3	2.327	0.803
247	204.5	366.8	2.368	0.800	208.3	378.0	2.332	0.807
248	205.4	372.4	2.374	0.805	209.2	383.8	2.337	0.812
249	206.3	378.1	2.379	0.809	210.1	389.7	2.343	0.816
250	207.2	383.9	2.385	0.813	211.0	395.7	2.349	0.821
251		389.7	2.390	0.818		401.7	2.354	0.825
252		395.6	2.396	0.822		407.9	2.359	0.830
253		401.6	2.401	0.827		414.1	2.365	0.834
254		407.7	2.407	0.831		420.4	2.370	0.838
255		413.9	2.412	0.835		426.9	2.376	0.843
256		420.2	2.418	0.840		433.4	2.381	0.847
257		426.5	2.423	0.844		440.0	2.386	0.852
258		433.0	2.429	0.849		446.7	2.392	0.856
259		439.6	2.434	0.853		453.5	2.397	0.861
260		446.2	2.440	0.858		460.4	2.403	0.865

TABLE 86

Giving in grams the values obtained by dividing the body weight by the body length in millimeters. Based on data in table 85

BODY LENGTH	RATIO		BODY LENGTH	RATIO		BODY LENGTH	RATIO	
	Male	Female		Male	Female		Male	Female
50	0.09	0.09	87	0.23	0.24	124	0.38	0.39
51	0.09	0.10	88	0.24	0.24	125	0.39	0.39
52	0.10	0.10	89	0.24	0.24	126	0.39	0.40
53	0.10	0.11	90	0.24	0.25	127	0.40	0.40
54	0.11	0.11	91	0.25	0.25	128	0.40	0.41
55	0.11	0.11	92	0.25	0.26	129	0.40	0.41
56	0.12	0.12	93	0.25	0.26	130	0.41	0.42
57	0.12	0.12	94	0.26	0.26	131	0.41	0.42
58	0.12	0.13	95	0.26	0.27	132	0.42	0.43
59	0.13	0.13	96	0.27	0.27	133	0.42	0.43
60	0.13	0.14	97	0.27	0.28	134	0.43	0.44
61	0.14	0.14	98	0.27	0.28	135	0.43	0.44
62	0.14	0.14	99	0.28	0.28	136	0.44	0.45
63	0.14	0.15	100	0.28	0.29	137	0.44	0.45
64	0.15	0.15	101	0.29	0.29	138	0.45	0.46
65	0.15	0.16	102	0.29	0.30	139	0.45	0.46
66	0.16	0.16	103	0.29	0.30	140	0.46	0.47
67	0.16	0.16	104	0.30	0.30	141	0.46	0.47
68	0.16	0.17	105	0.30	0.31	142	0.47	0.48
69	0.17	0.17	106	0.30	0.31	143	0.47	0.48
70	0.17	0.17	107	0.31	0.31	144	0.48	0.49
71	0.17	0.18	108	0.31	0.32	145	0.49	0.50
72	0.18	0.18	109	0.32	0.32	146	0.49	0.50
73	0.18	0.18	110	0.32	0.33	147	0.50	0.51
74	0.19	0.19	111	0.33	0.33	148	0.50	0.51
75	0.19	0.19	112	0.33	0.34	149	0.51	0.52
76	0.19	0.20	113	0.33	0.34	150	0.51	0.52
77	0.20	0.20	114	0.34	0.34	151	0.52	0.53
78	0.20	0.20	115	0.34	0.35	152	0.52	0.54
79	0.20	0.21	116	0.35	0.35	153	0.53	0.54
80	0.21	0.21	117	0.35	0.36	154	0.54	0.55
81	0.21	0.21	118	0.36	0.36	155	0.54	0.55
82	0.21	0.22	119	0.36	0.37	156	0.55	0.56
83	0.22	0.22	120	0.36	0.37	157	0.55	0.57
84	0.22	0.23	121	0.37	0.38	158	0.56	0.57
85	0.23	0.23	122	0.37	0.38	159	0.57	0.58
86	0.23	0.23	123	0.38	0.38	160	0.57	0.59

TABLE 86—Concluded

BODY LENGTH	RATIO Male	RATIO Female	BODY LENGTH	RATIO Male	RATIO Female	BODY LENGTH	RATIO Male	RATIO Female
161	0.58	0.59	195	0.84	0.86	228	1.20	1.24
162	0.59	0.60	196	0.85	0.87	229	1.22	1.25
163	0.59	0.61	197	0.86	0.88	230	1.23	1.27
164	0.60	0.61	198	0.87	0.89	231	1.24	1.28
165	0.61	0.62	199	0.88	0.90	232	1.26	1.29
166	0.61	0.63	200	0.89	0.91	233	1.27	1.31
167	0.62	0.63	201	0.90	0.92	234	1.29	1.32
168	0.63	0.64	202	0.91	0.93	235	1.30	1.34
169	0.63	0.65	203	0.92	0.94	236	1.32	1.35
170	0.64	0.65	204	0.93	0.95	237	1.33	1.37
171	0.65	0.66	205	0.94	0.96	238	1.34	1.38
172	0.65	0.67	206	0.95	0.97	239	1.36	1.40
173	0.66	0.68	207	0.96	0.98	240	1.37	1.41
174	0.67	0.68	208	0.97	0.99	241	1.39	1.43
175	0.68	0.69	209	0.98	1.00	242	1.41	1.45
176	0.68	0.70	210	0.99	1.02	243	1.42	1.46
177	0.69	0.71	211	1.00	1.03	244	1.44	1.48
178	0.70	0.71	212	1.01	1.04	245	1.45	1.50
179	0.71	0.72	213	1.02	1.05	246	1.47	1.51
180	0.71	0.73	214	1.03	1.06	247	1.49	1.53
181	0.72	0.74	215	1.04	1.07	248	1.50	1.55
182	0.73	0.75	216	1.06	1.08	249	1.52	1.57
183	0.74	0.75	217	1.07	1.10	250	1.54	1.58
184	0.75	0.76	218	1.08	1.11	251	1.55	1.60
185	0.75	0.77	219	1.09	1.12	252	1.57	1.62
186	0.76	0.78	220	1.10	1.13	253	1.59	1.64
187	0.77	0.79	221	1.12	1.15	254	1.61	1.66
188	0.78	0.80	222	1.13	1.16	255	1.62	1.67
189	0.79	0.81	223	1.14	1.17	256	1.64	1.69
190	0.80	0.82	224	1.15	1.18	257	1.66	1.71
191	0.80	0.82	225	1.17	1.20	258	1.68	1.73
192	0.81	0.83	226	1.18	1.21	259	1.70	1.75
193	0.82	0.84	227	1.19	1.23	260	1.72	1.77
194	0.83	0.85						

CHAPTER 14

GROWTH IN TERMS OF WATER AND SOLIDS

1. Percentage of water in blood. 2. Percentage of water in brain and spinal cord.

(1) *Percentage of water in the blood.* Hatai (MS '15) has determined the percentage of water in the blood of a small series of Norways.

The Norways were recently caught and examined before the day's feeding. The rat was chloroformed, but before the heart ceased beating it was exposed in situ, the tip clipped away and the blood from it caught in a small glass weighing bottle. The fresh weight was immediately taken and after drying at 95°C. for a week the weight of the residue was obtained. The results are given in table 87.

TABLE 87

Giving the percentage of water in the blood of the Norway rat, Hatai (MS., '15)

SEX	NUMBER OF CASES	BODYWEIGHT, GRAMS		PERCENTAGE OF WATER IN BLOOD	
		Range	Mean	Range	Mean
M...........	5	114–169	144	79.02–82.05	80.34
M...........	6	173–440	243	79.92–81.53	80.52
F............	4	103–190	148	79.82–80.35	80.05
F............	5	199–304	271	79.52–81.77	80.82

(2) *Percentage of water in the brain and spinal cord.* Since the percentage of water in the nervous system is most closely linked with age, a precise determination in the case of the Norway rat is wanting, by reason of the difficulty of rearing the Norway in captivity. A few data are however at hand.

From Norways born in captivity from trapped females we obtain the percentages according to age, given in table 88. It

TABLE 88.

Showing the percentage of water in the brain and spinal cord of the Norway rat at different ages (sexes combined), (Donaldson and Hatai, '11)

NUMBER OF CASES	AGE IN DAYS	BODY WEIGHT	PERCENTAGE OF WATER	
			Brain	Spinal cord
		grams		
5	1	5.1	88.2	87.0
3	10	12.2	86.9	83.3
8	13	18.1	85.3	82.5
6	15	17.7	84.5	81.0
11	16	26.1	82.8	79.4
10	19	25.5	81.5	77.8
7	25	32.6	80.9	76.7
4	40	35.8	79.2	74.3
5	47	38.5	79.3	74.0

is to be noted that for the most part the rats grew poorly, as shown by the body weights. (Donaldson and Hatai, '11.)

For Norways trapped in Philadelphia and killed shortly after capture, we obtain, according to body weight, sexes combined, the percentage values of water in brain and spinal cord which are given in table 89.

A comparison of the values for the Norways and Albinos shows that the percentage of water in the Norways tends to run above that in the Albinos—being + 0.37 per cent for the brain and + 0.73 per cent for the spinal cord.

TABLE 89

Giving the percentage of water in the brain and spinal cord of the Norway rat according to body weight (sexes conbined). Based on Donaldson and Hatai, '11, tables 11 and 14

BODY WEIGHT IN GRAMS	NUMBER OF CASES (SEXES COMBINED)	PERCENTAGE OF WATER (SEXES COMBINED)	
		Brain	Spinal cord
195	7	78.4	71.3
205	8	78.4	71.7
215	14	78.6	71.7
225	13	78.6	70.8
235	16	78.5	71.4
245	14	78.7	71.5
255	12	78.5	71.5
265	14	78.3	70.1
275	11	78.3	70.3
285	15	78.3	70.4
295	9	78.6	71.0
305	11	78.6	70.1
315	11	78.4	70.0
325	12	78.0	69.3
335	10	78.2	70.3
345	9	78.2	69.7
355	3	78.3	70.7
365	8	78.1	68.0
375	7	78.3	71.2
385	5	78.0	69.6
395	3	78.3	69.8
405	2	78.0	69.0
415	5	78.4	70.2
425	2	78.0	69.0
435			
445	6	78.5	69.6
455	1	78.0	69.0
465	1	78.0	67.0

Growth in terms of WATER and Solids: REFERENCES Donaldson and Hatai '11.

CHAPTER 15

REFERENCES TO THE LITERATURE

Introduction. The list of references which follows does not claim to be complete and in several directions is intentionally selective. For example, many bacteriological investigations in which the rat has been used are omitted, as are also a large number of descriptive papers belonging to the earlier zoölogical literature. To this list of omissions belong about a dozen titles which do not appear to be accessible in any of the larger libraries of the United States; the printing of such titles was therefore regarded as superfluous.

On the other hand, it has been my intention to include the titles of all the papers which record anatomical investigations and physiological studies, so far as these were generally available.

At the outset of such a plan one meets with the difficulty that the rat has been used in many cases where the fact is not stated in the title of the paper, and moreover in other instances it is only one of several animals which have been examined or tested.

In the selection of the titles of this class the plan has been to include everything which gave information—no matter how restricted—that applied to the rat. Of course it is inevitable under these circumstances that some papers should have been overlooked.

In accordance with the general plan of the book we have included papers not only on the wild Norway and the domesticated Albino, but also on both forms of the house rat, Mus rattus rattus and Mus rattus alexandrinus.

The specific names and designations as given by the authors are quoted without comment but can be revised by reference to the foregoing section on nomenclature. Now and then I have permitted myself an annotation when this was pertinent.

Thus far the statements apply to the literature which follows and which is arranged alphabetically by authors' names and under authors by date.

It was desirable at the same time to get some sort of a subject classification, and this has been done in the following manner.

At the end of each chapter, references to the literature bearing on the subject of the chapter are given by author's name and date. The full reference appears in the list of the end of the volume. The chapter lists contain not only the citations in the text, but also other references which have not been cited there. The presentation is not uniform but dictated by the arrangement of the chapter. Where possible the references are given in alphabetical order without subdivisions, but where it will be of advantage to have the references grouped according to the sub-headings, this is done, although under this plan the same reference often appears under more than one sub-heading.

REFERENCES TO THE LITERATURE

Addenda: Pp. 265–266

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